NEW SHOPS AND OFFICES.

The D. A. Tompkins Company, Charlotte, N. C.

COTTON SEED OIL,

History and Commercial Features.

With Illustrations

OF THE VARIOUS MACHINES USED IN ITS MANUFACTURE.

With Estimates

OF COSTS OF PLANTS, COSTS OF OPERATIONS, AND PROFITS UNDER DIFFERENT CONDITIONS.

By D. A. TOMPKINS.

CHARLOTTE, N. C.
1902.

Caution.

Most of this pamphlet is copied from Chapter XI, of a book, "Cotton and Cotton Oil," by D. A. Tompkins.

For Table of Contents of the book, see latter part of this pamphlet.

The book is copyrighted; this pamphlet is copyrighted. It is unlawful to copy any of the matter (with or without giving credit) except by written permission of the Author.

Infringements will be prosecuted.

Presses Observer Printing House,
Charlotte, N. C.

Cotton Seed Oil.

History and Commercial Features

From time immemorial, the praise of the olive tree has been sung, both in sacred and profane literature. For centuries before and after the Christian era, it was held, and is still held, in the highest esteem. This high estimation in which the olive tree is held, comes undoubtedly from the fact that in its fruit and oil, mankind has heretofore obtained more that is useful than from any other plant or tree.

It was an olive branch that the dove brought back to Noah in the ark, to give courage and hope to survivors of the flood. The olive branch is well nigh an universal emblem of peace among all peoples.

In ancient times, and in many countries still, olive oil is the principal, and in many cases the only cooking grease. Our Anglo-Saxon habit of using animal fats in its stead, is the exception, and not the rule. In The Arabian Nights, the story goes, that forty thieves were concealed in jars that were supposed to contain oil.

Throughout the same ages, the cotton plant has always existed; but, remarkable as it may seem, its value was never fully understood, until within the past 25 years.

The three prime necessities of the human race are: food, clothing and shelter. Towards these, the olive tree furnishes its fruit and oil for food, and in a very limited extent its wood for construction. The cotton plant now supplies lint, from which clothing for the body, the bed and household (carpets) is made. It supplies oil for cooking purposes, and for many industrial uses, such as for lamps in mines, and to a limited extent for lubrication, for making soap, glycerine, candles, butter, lard, and for innumerable other uses.

The cotton seed meal is used for supplying ammonia and other constituents in commercial fertilizers, for cattle food in dairies, for fattening beef, sheep, and for various other purposes. Lately, however, it is being mostly used as a food for cattle and sheep. This is especially the case at dairy farms, and where cattle are being fatted for beef, and at saw mills, where oxen are used to haul logs.

In truth, we are suddenly brought to a realization of the fact that the cotton plant gives us more than the olive tree ever gave to mankind. And, by perfecting machinery and methods for the production of useful products from cotton seed, values which have for centuries been unknown, have suddenly been brought to light. The men who have been most instrumental in the production of valuable products from cotton seed, have been doing a work not only for themselves, but for the country at large, and for all humanity

The First Cotton Seed Oil Mills.

The first mill was built at Natchez, Miss., in 1834. A Mr. Martin operated a cotton seed oil mill in New Orleans as far back as 1847. But few other mills were built prior to the Civil War. Immediately after the Civil war of 1860-65, several mills were built, some of which succeeded, and some failed.

In 1869 General E. P. Alexander built a cotton seed oil mill at Columbia, S. C. Following this, other mills were built in different parts of the cotton growing area. By 1880, the business of crushing cotton seed had developed into a distinct and entirely legitimate business, but the process employed, and everything pertaining to the industry was held in great secrecy.

The oil was found to be about the same as olive oil, and the cake and meal was largely exported and used in England, and on the Continent, for stock food. What was purchased in America was principally used as a fertilizer. The oil was used principally as a substitute for, or an adulterant of, olive oil, and readily sold in the crude state, at from 50 to 60 cents per gallon.

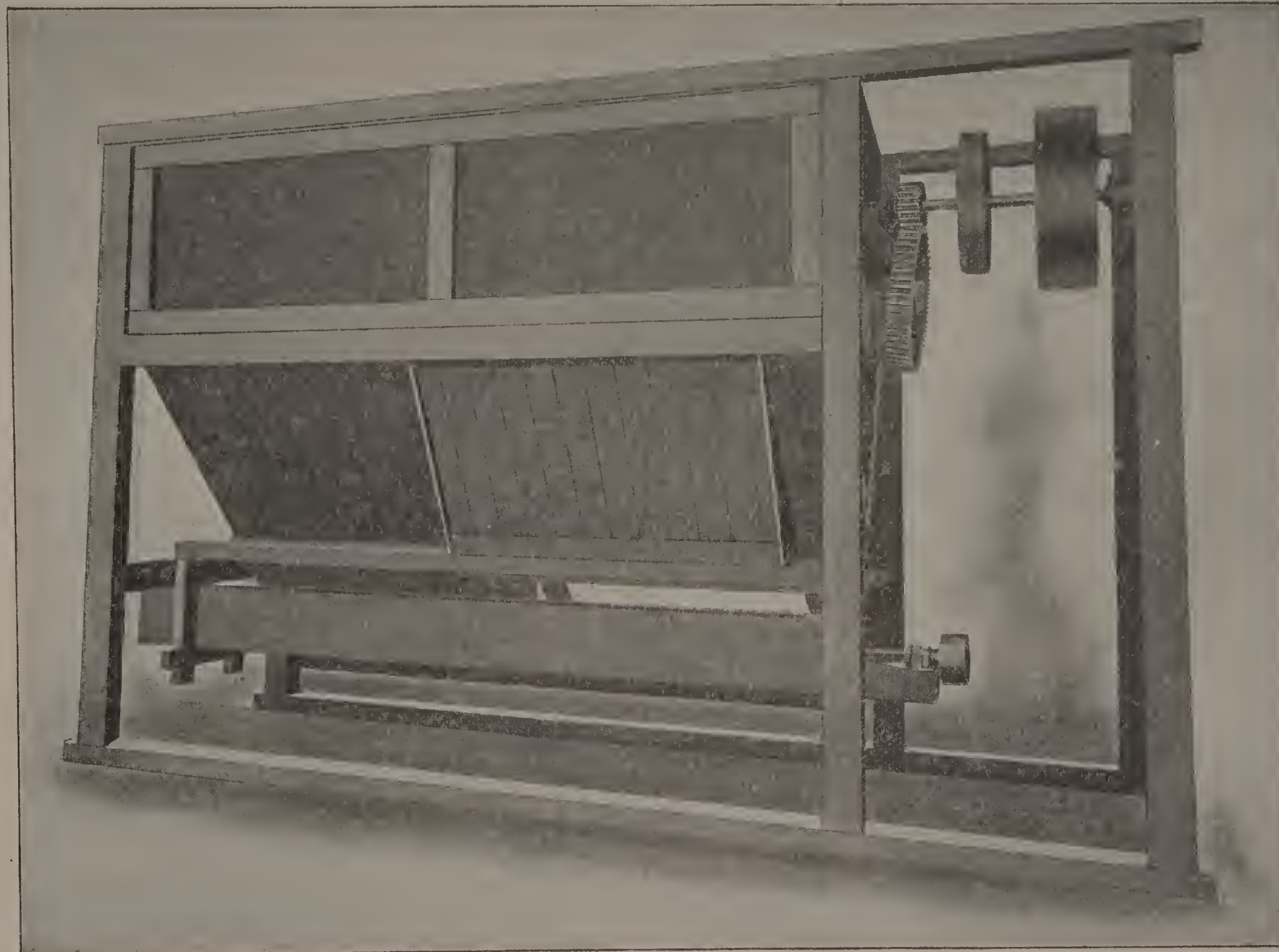

FIG. 1. Sand and Boll Screen.

Those mills that were managed with even a rough approximation to ordinary care and business judgment made very large profits. As the business still developed and the price of oil became less, the pork packers discovered that it could be advantageously used with certain beef products to make an excellent cooking fat, to take the place of hog lard. Since its adaptation to this use, large and increasing quantities have been consumed by concerns that slaughter cattle and dress beef for market. Since about 1880, the consumption of cotton seed oil has been further increased by its use for packing sardines on the coast of Maine, for making butter in America, Holland and elsewhere, and for numerous other purposes.

The Machinery Used.

The principal machinery used in early cotton seed oil mills was brought from England. It no doubt comprised such heaters and presses as were used to crush oil from linseed, Egyptian cotton seed, and other oil seeds that were produced in or shipped to England. Egyptian cotton seed are black and lintless, very similar to seed from Sea Island cotton in this country. The process of working them was very simple They were first crushed under old fashioned mulling stones, then put in steam jacketed kettles with mechanical stirrers, and cooked. The product was dumped from the kettle or heater into a wooden bin, and from the bin it was put into a hydraulic press containing about five boxes, and put under about two to three thousand pounds pressure to the square inch, on rams ten to twelve inches in diameter.

Upland American seed are not entirely free from lint. On account of the quantity of oil this lint is capable of absorbing, and also on account of the injury which the lint is to the cake as a food stuff, it was important to separate the hull from the meats. This was accomplished by the use of a huller, a machine to cut the seed to pieces, and screening out the meats from the hulls, in bolting chests, having the reel clothed with wire cloth.

The earlier mills were either built by foreign mechanics,

or native Southern mechanics of ante-bellum type, both of whom were dogmatic, opinionated and incompetent. It commonly required about two years for these to build a mill, and get it into successful operation.

The costs, profits, processes and all other information about an oil mill were kept carefully concealed by owners and millwrights or experts.

From 1882 to 1884, the subject was first looked into from an engineering point of view. In 1884, there was erected the first cotton seed oil mill ever built from designs made by the modern type of educated and practical American engineer.

Most of the seed worked in the United States are upland seed. The average physical composition of a ton of these upland seed as received at the oil mill is about as follows:

Short lint	70 lbs
Hull	910 lbs
Oil (51 gals)	382 lbs
Meal	600 lbs
Sand and other foreign matter	38 lbs
	2,000

These proportions vary with seasons, soils, character of ginning and care or conscience of the farmer, ginner or seed agent. By bad ginning there may be 125 pounds of lint left on the seed, and by very good ginning, the seed may be cleared of lint to within 50 pounds.

The best possible oil mill is one in which the separation of the above constituents is most nearly complete and put in marketable shape at the least expense per ton.

The process of manufacture in American oil mills underwent very little change until about 1880. From that time forward, great improvement has been made in machinery, such as improved hullers, improved linters, steel plate boxes in presses (requiring no hair mats), chilled rolls in place of muller stones, etc, etc.

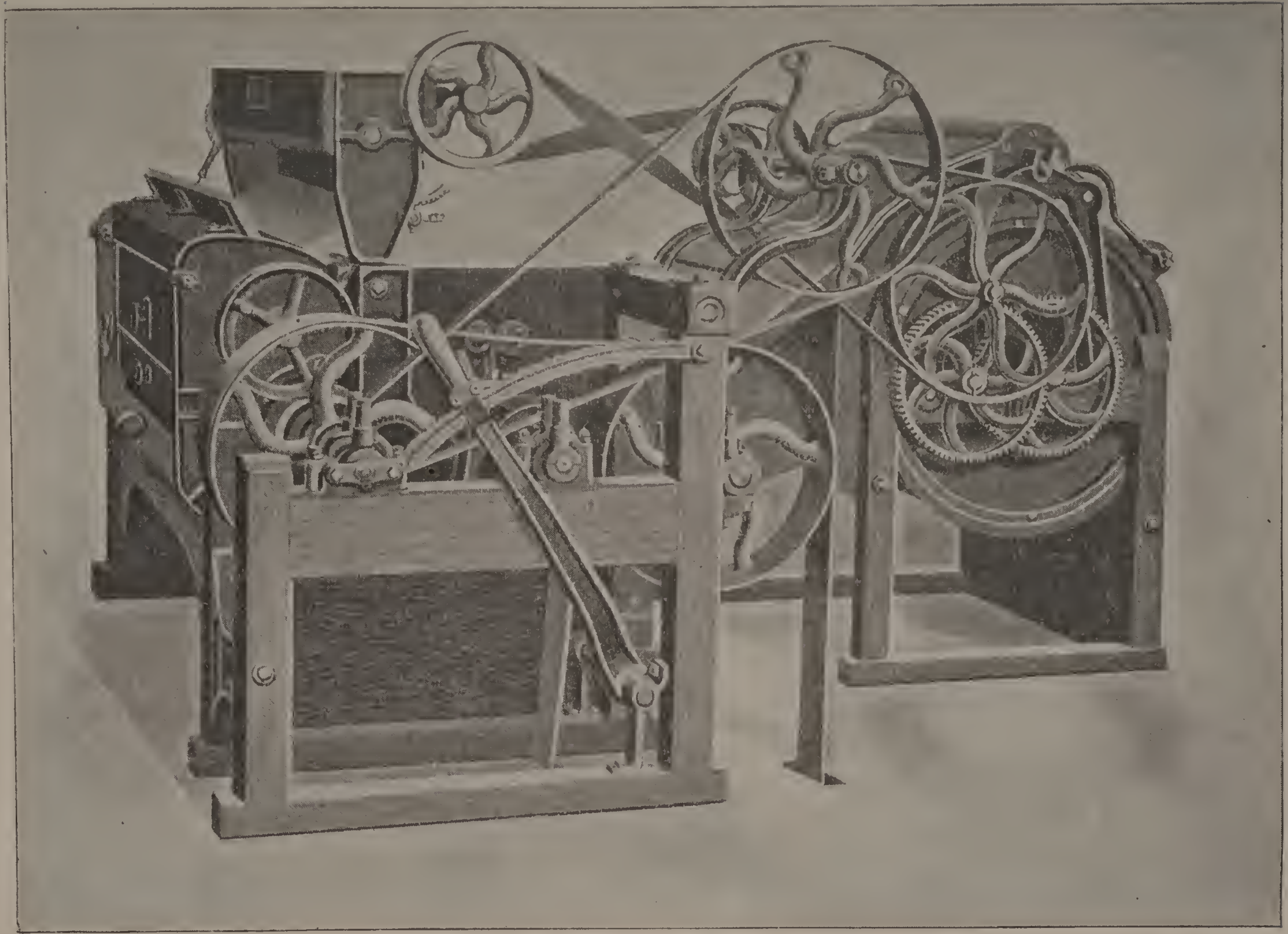

FIG. 2. Cotton Seed Linter.

The Process.

The process now conducted in first-class mills is about as follows:

1. The seed are cleaned of sand.

2. Then cleaned of the other foreign substances, such as bolls, pieces of wood, etc.

3. They are then carried to the linters, and re-ginned for a part of the short lint.

4. They are then carried to the huller, which cuts them to pieces.

5. Then in a reel the meats are separated from the hulls.

6. The hulls are then taken out, heretofore to the fire room for fuel, but latterly to be sold as cattle feed.

7. The meats are taken to the rolls which crush them, breaking the oil cells.

8. From the rolls, the meats go into heaters, in which they are cooked.

9. From the heaters, meats are taken into the former, where cakes are formed and enclosed in cloth.

10. The cakes are placed in the press and the oil extracted by pressure.

11. The cake remaining in the press is taken out, allowel to cool, and may then be cracked and ground into meal.

The following tables will exhibit the variety of results from operating various kinds of oil mills, under different conditions.

TABLE VI.

SHOWING PRODUCTS AND VALUES OBTAINED FROM ONE TON OF SEED IN THE EARLY OIL MILLS:

1,000 lbs hulls, used as fuel		$ .30
775 lbs meal @ 90c		6.98
225 lbs oil=30 gallons @ 60c		18.00
2,000 lbs seed, giving product worth		$25.28
Cost of seed	$10.00	
Cost of working	5.00	$15.00
Profit		$10.28

A mill of this design capable of working 5,000 tons of seed per year, should therefore have made, and often did make, with good management, $50,000 per year.

At the present day, meal remains at about the same price shown in the above table. Oil, however, has declined fully half. By improved mills and machinery, the cost per ton of working seed has been much reduced, and the quantity of oil per ton has been increased.

Many mills exist that can never be made first-class, except by entire reconstruction. Of the mills still being built, there is much variation in the quality of the design and workmanship on the machinery.

TABLE VII.

SHOWING PRESENT PRODUCT AND VALUES OBTAINED FROM ONE TON OF SEED IN AN OLD OR BADLY CONSTRUCTED OIL MILL IN A GOOD YEAR.

Oil, 39 gals at 30 cents per gal		$11.70
Meal, 675 pounds at $1.00 per cwt		6.75
Hull, 950 pounds at $3.00 per ton		1.42
Lint, 25 pounds at 3c		.75
		$20.62
Cost of seed delivered at mill	$14.00	
Cost of working, bags, barrels, etc	3.50	
Cost of fuel	1.00	18.50
Profit		$2.12

A mill under these circumstances, working 5.000 tons of seed per year, could therefore make a profit of more than $10.000.

TABLE VIII.

SHOWING PRESENT PRODUCTS AND VALUES OBTAINED FROM ONE TON OF SEED IN AN OLD OR BADLY CONSTRUCTED MILL, IN A BAD YEAR.

Oil, 35 gals at 20c		$7.00
Meal, 675 pounds at 90c per cwt		6.08
Hull, 950 pounds at $3.00 per ton		1.42
Lint, 25 pounds at 3c		.75
		$15.25
Cost of seed delivered at mill	$12.00	
Cost of working, bags, barrels, etc	3.50	
Cost of fuel, per ton	1.00	16.50
Loss		$1.25

A mill under these circumstances, working 5,000 tons of seed per year would lose over $5,000.

TABLE IX.

SHOWING PRESENT PRODUCTS AND VALUES OBTAINED FROM ONE TON OF SEED IN WELL DESIGNED MILL WITH THE BEST MACHINERY, IN A GOOD YEAR.

Oil, 40 gals at 30c	$12.00
Meal, 675 pounds at $1.00 cwt	6.75
Hull, 950 pounds at $4.00 per ton	1.90
Lint, 30 pounds at 3c	.90
	$21.55

Cost of seed	$15.00	
Cost of working, bags, etc	3.00	
Cost of fuel	.50	$18.50
Profit		$3.05

A mill under these circumstances, working 5,000 tons of seed per year would make a profit of about $15,000.

TABLE X.

SHOWING PRESENT PRODUCTS AND VALUES OBTAINED FROM ONE TON OF SEED IN A WELL DESIGNED MILL WITH THE BEST MACHINERY, IN A BAD YEAR.

Oil, 40 gals at 20c		$8.00
Meal, 675 pounds, at 90c		6.08
Hull, 950 pounds at $4.00		1.90
Lint, 30 pounds at 3c		.90
		$16.88
Cost of seed	$12.00	
Cost of working, bags, etc	3.00	
Cost of fuel	.50	15.50
Profit		$1.38

A mill under these circumstances, working 5,000 tons of seed per year, would make a profit of nearly $7,000 This would be a dividend of 14 per cent. on a capital of $50,000 in the worst year. This shows the value of first-class designs in an oil mill.

These figures are all average estimates. There is, of course, great variation in prices at different times, and in prices at different parts of the seed territory. They apply also to the oil mill business, without supplemental or auxiliary adjuncts, that are now coming into vogue.

As a matter of fact, the best modern concerns in the East comprise in one plant, a ginnery, oil mill, fertilizer works and cotton mill, each department helping the other.

In the operation of an oil mill, the personality of the manager and his capacity to make quick and accurate decisions on commercial points, has a greater influence on the profits than is the case in most other businesses.

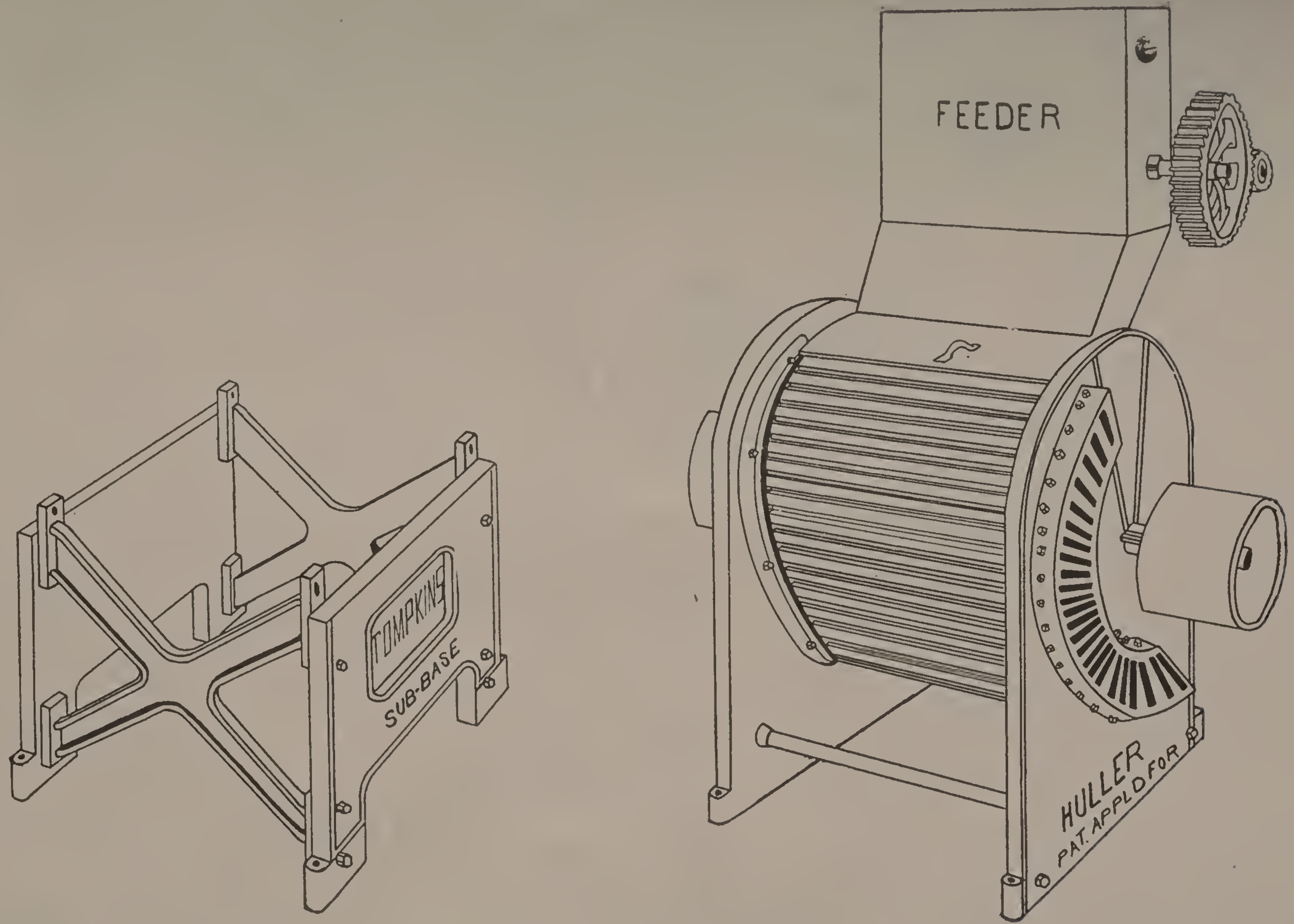

FIG. 3. Tompkins' Cotton Seed Huller and Feeder.

The Tompkins Huller, Fig. 3, is built in two sizes—No. 1 with cylinder 20 inches in diameter, 30 inches long, and No. 2 with cylinder of same diameter, 17 inches long. The large size has a capacity of 40 to 100 tons of seed per day of 24 hours. It has two pulleys, 15x9, and should run 900 revolutions per minute. The feeder (which is furnished at an extra cost) is run by an independent pulley, 18x4, and should run 100 revolutions per minute.

The smaller size has a capacity of 20 to 40 tons. It should run at same speed as the No. 1.

These machines are much heavier and more rigid than any other huller on the market. The designs have been worked out as the result of many years' practical use of hullers, and there are many improvements over the old forms.

The engraving shows a sub-base, which is furnished at an extra cost with either huller when it is desired to have them stand higher from the floor.

The cylinder and the knives are machined all over, and the knives can be set without the use of paper liners.

The bearings are ring oiling.

In Fig. 4 is shown a separating device attached to the Tompkins huller, standing on a sub-base. Heretofore it has been necessary to elevate the material from the huller and deliver it into a separating screen. The use of the sub-base raises the huller so that it can deliver direct into the separating machine standing on the same floor. The separator consists of a frame carrying a cage of perforated steel and a shaft with beating blades, which stir the material and beat the meats through into a conveyor, which is a part of the machine.

The hulls are spouted out at the ends.

For small mills there are many who prefer this beater separator to the screen separator.

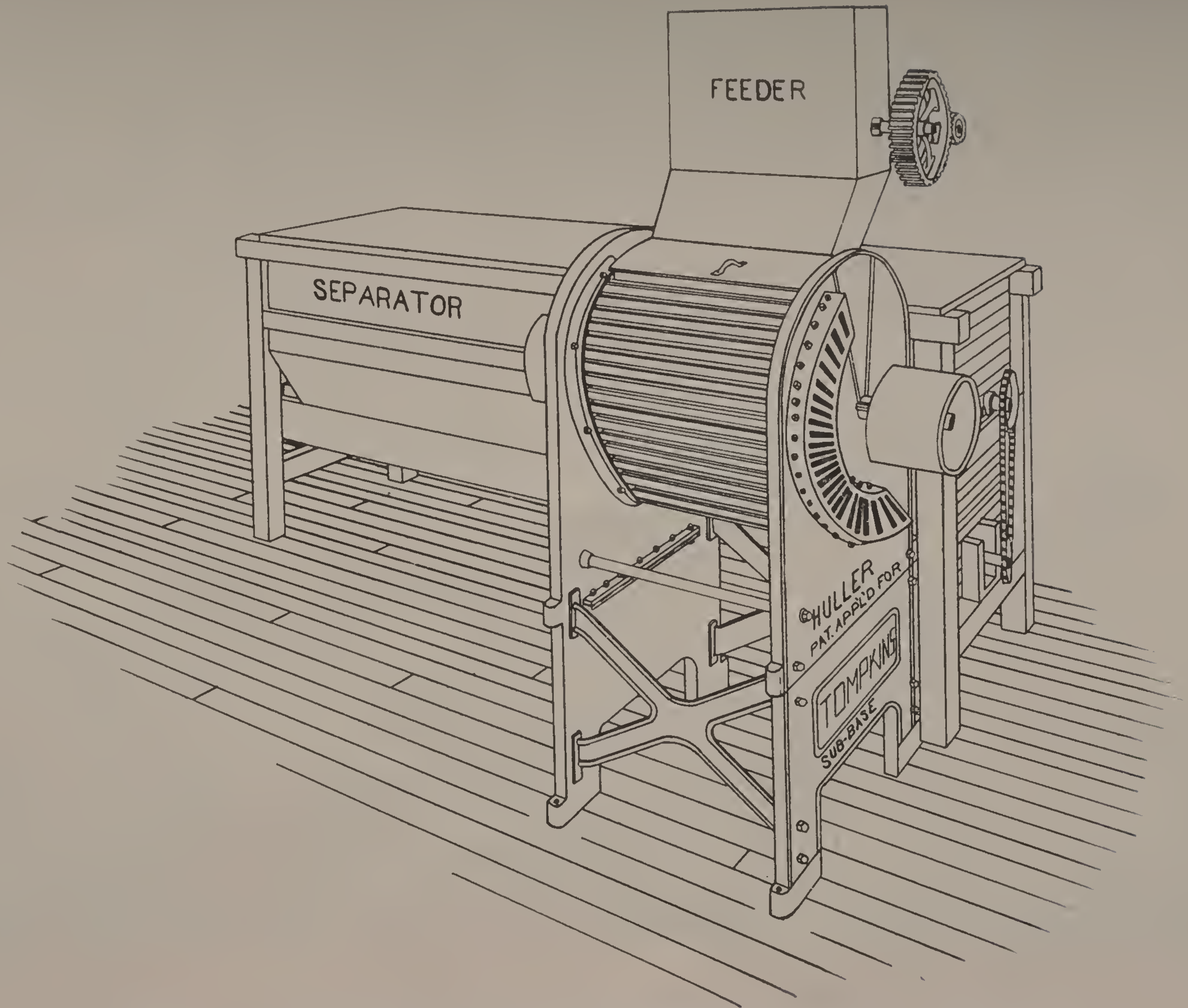

FIG. 4. Tompkins' Combined Huller and Beater Separator.

Hulls for Fuel.

Throughout the entire South, the use of hulls for fuel has been totally abandoned, and they are being used as stock food, many mills having added the business of fattening cattle for beef. The use of hulls and meal together has been thoroughly demonstrated to be excellent for fattening cattle for beef, and also for feeding dairy cattle. These combinations have been, in fact, so perfected in design that several plants have been built to put the seed cotton as a raw material through a complete cycle of operations, as follows:

1. Separating the lint from the seed.

2. Separating the short lint.

3. Separating the hull and meat.

4. Separating the oil and meal.

5. Mixing meal and other ingredients for fertilizer.

6. Feeding hulls and meal to cattle, using the manure as a fertilizer.

7. Spinning and weaving the lint, making yarn and cloth.

Thus, taking seed cotton as a raw material, the products are taken out that are valuable for clothing and animal food, and what is useless for these purposes is returned to the soil, to make the new crop.

Table XI. exhibits the value that might be obtained from the seed from ten million bales of cotton, if manufactured under the ordinary improved processes now in common use, and sold at current prices.

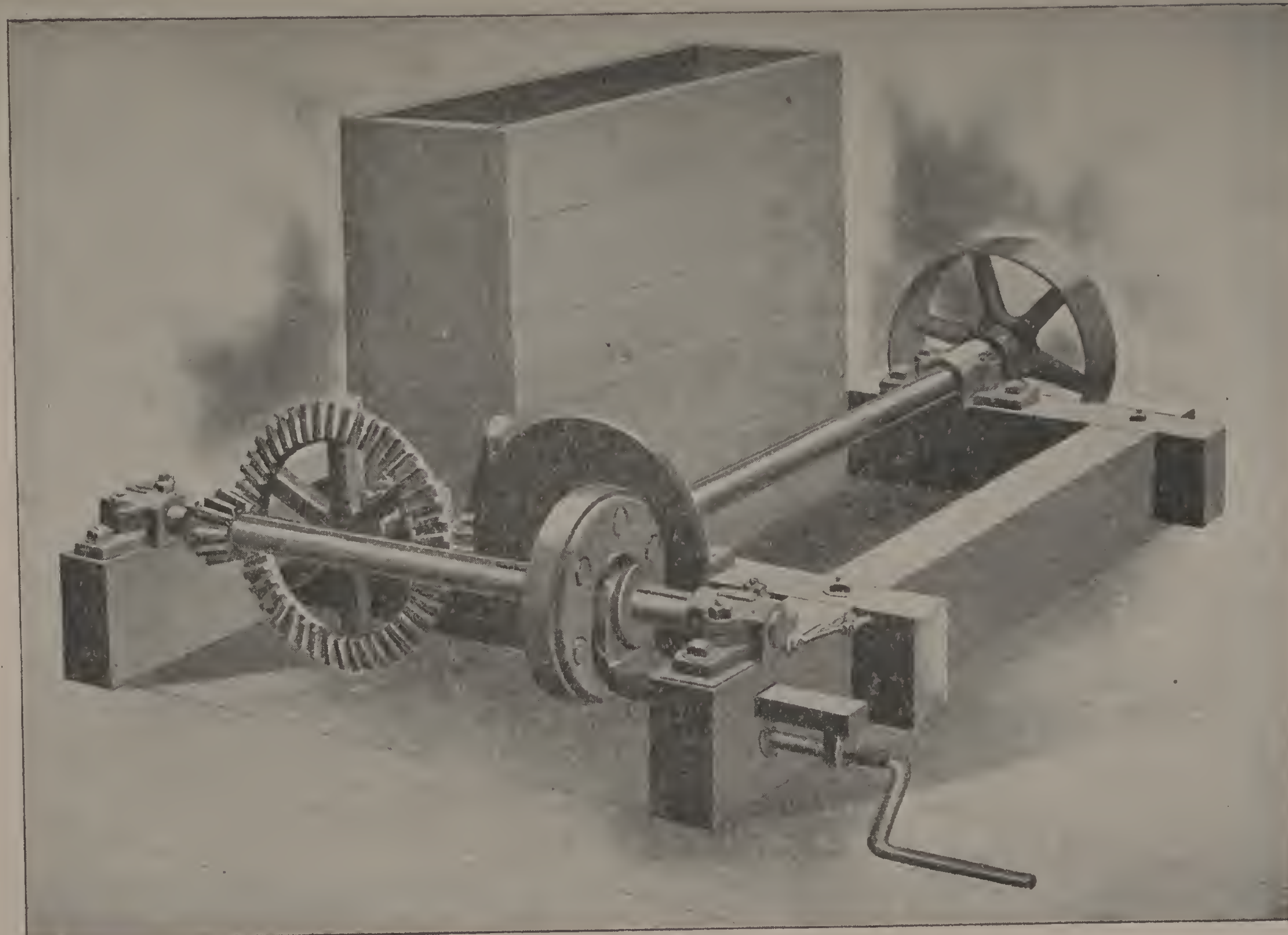

Fig. 5. Huller Feeder.

TABLE XI.

SHOWING VALUE OF ORDINARY MANUFACTURED PRODUCTS OF COTTON SEED FROM TEN MILLION BALES OF COTTON.

200 million gals oil (40 gals per ton from five million tons) at 30c..	$60,000,000
Two and a half million tons hulls at $4.00..	10,000,000
One and two-thirds million tons of meal at $21.00	35,000,000
100 million pounds lint at 3c	3,000,000
Total	$108,000,000

The total seed crop of 1900 as disposed of by ante-bellum planters would not have been worth $5,000,000, as against more than $100,000,000, if utilized according to the present known methods of obtaining values out of them.

But the values indicated in the above table represent even much less than the possible results.

Two and a half million tons of hulls will fatten for market two and a half million heavy beef cattle, or would maintain a proportionate number of dairy cattle.

From these cattle come beef, tallow, glue, all dairy products, and still further developed industries. The oil, besides being used as a cooking oil, gives also glycerine, candles, soap, lard, butter and indefinite other products and industries. Notable as an example of one of the uses to which it goes: The cylinders of the phonograph are made from the "soap stock" residue in refining cotton oil.

Delinting Machinery.

There is a legend in the oil business that there is a fortune in store for the man who invents a means of cleaning the lint from upland cotton seed so that they have the appearance of Sea Island or Egyptian seed. The country is

full of inventors trying to make seed cleaning machines. Most of the workers at the problem have never stopped to ask the question where the fortune would come from, or why it should even be expected that there would be profit in a perfected delinting machine. Many machines have been invented and made—quite a number of good ones, but nobody has yet made the fortune.

Whenever any evidence is exhibited at all in support of the assertion or idea that a delinting machine would be valuable, the argument is about as follows: The price of seed in America is $10.00 per ton; in England it is quoted about $24.00 per ton Therefore, if a machine could be invented to make American seed look like the Egyptian, there would be a fortune it.

As a matter of fact, when seed are quoted at $10.00 in this country and $24.00 in England, the meaning of a ton in this country is 2,000 pounds, and in England 2,240 pounds. If this be considered, and there be added to the cost of seed in this country the cost of cleaning, freight to port, ocean freight, handling and commission on the other side, and freight to mill on the other side, it will be found cheaper to work seed in America by the usual American process. The seed from the American sea island cotton are already clean, and are already near ports in most cases, and yet no important business has ever been developed in shipping them abroad. The reason is, that if they can be purchased at a reasonable price, it pays better to work them in this country than to attempt to ship them.

Linting.

Much has been said about the value of the lint that is not true. After seed are well linted by an ordinary linter, what is left is of not much value as fibre or paper stock

A good linter gets from 20 to 30 pounds of lint from a ton of seed, when about five tons per day is put through one machine. It is a considerable question whether it is worth the cost to take more than 30 pounds of lint from average seed.

Assuming the ability of the linters to get say 30 pounds

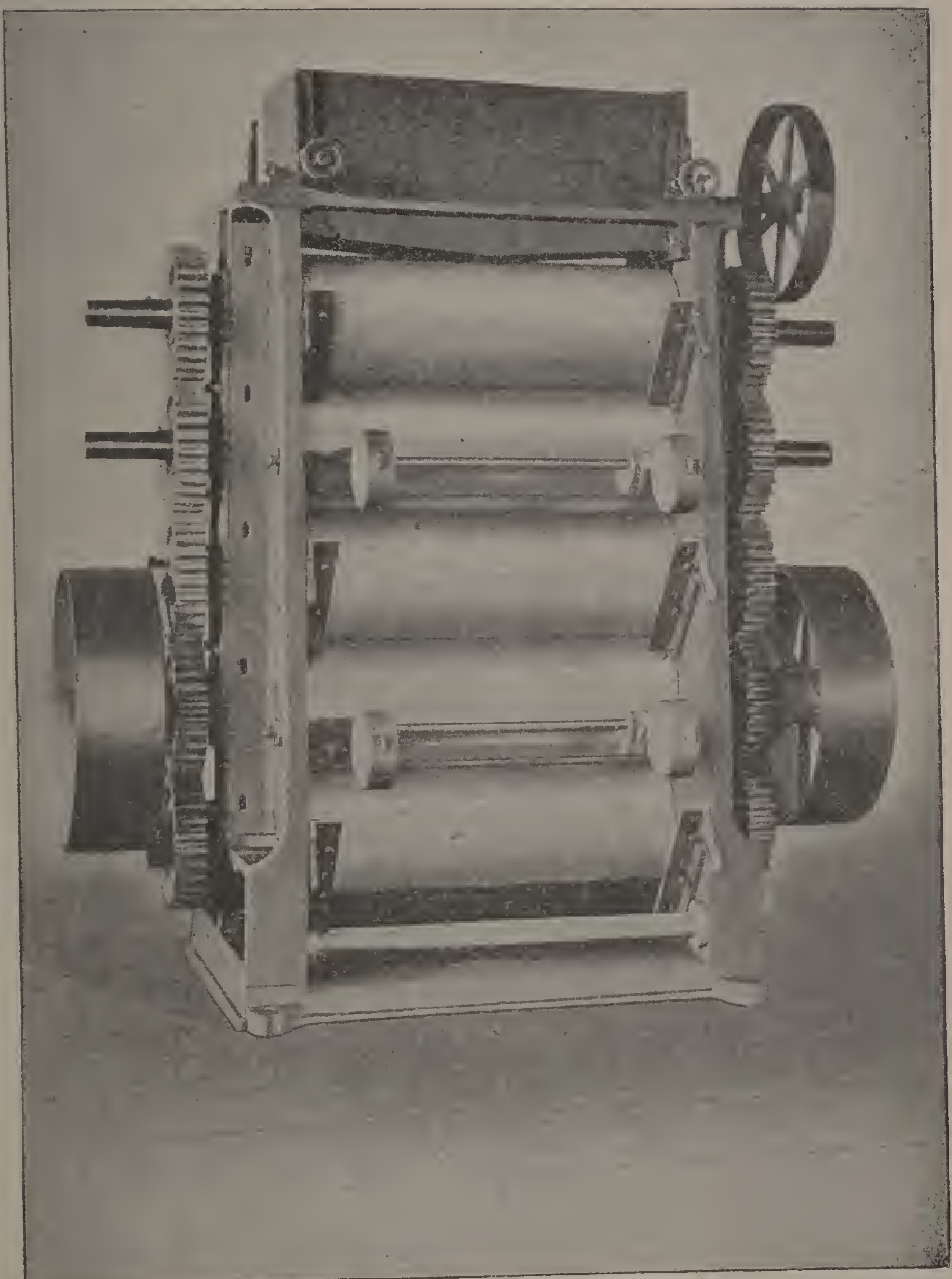

FIG. 6. Chilied Rolls.

of lint per ton, the linters may be so arranged as to run the entire seed first through one half the linters, getting fifteen pounds per ton, and then run them through the other half, getting fifteen pounds more. The first lint would sell for say 4 cents per pound, making 60 cents per ton. The second lint would bring say 2 cents per pound, making 30 cents per ton, making a total of 90 cents per ton.

On the other hand, running the seed through all the linters at one time would give, say 30 pounds of uniform quality, which would sell at about 3 cents per pound, making 90 cents per ton also. The question of profit would depend more on the market to be reached than upon anything in the mill.

Storing Cotton Seed.

Cotton seed are very perishable, and the danger of heating might be estimated at 10 per cent. of their value. By care, this may be reduced to 5 per cent. or less.

A mill having a capacity of 30 tons of seed per 24 hours, and a storage capacity of 1,000 tons of seed, from the 15th of September to the 15th of February, would work about 3,000 tons; allowing for breakdowns and holidays.

To work 5,000 tons instead of 3,000 may be accomplished by increasing storage capacity to the extent of 2,000 tons, making 3.000 instead of 1,000, and using the same machinery; or it may be done by leaving seed storage unchanged, and adding additional machinery to work the 2,000 tons additional seed in the same time.

By adding storage, there would be the following items of additional expense:

1. Liability of seed to rot or damage.

2. Interest on money invested in 2,000 tons stored seed.

3. Less oil per ton on stored seed than on seed worked fresh.

4. Less price on oil out of stored seed, if in any way heated.

5. Additional labor for working same tonnage for a longer time.

6. Interest on increased warehouse cost.

By adding new machinery there would be the following additional expenses and advantages:

1. Interest on value of additional machinery.

2. Repairs on additional machinery.

3. Less cost per ton, because the same force can usually operate the additional machinery and make the increased output in the same time.

4. The meal can be put on the market for the current year, instead of part of it having to be carried over to another season.

By having ample mill capacity, as against large storage capacity, and working seed practically as fast as received, banking facilities become a much simpler matter, and in all respects the manufacture is facilitated and cheapened. But there is a limit to the profitable capacity of a single mill. It is believed that the most profitable size mill ranges from 25 to 100 tons capacity, according to locality and amount of seed available. Mills larger than this become difficult to manage. One of the difficulties consists in the handling of the large amounts of seed which come by rail, during the short season in which seed are marketed. If larger capacity than 100 tons per day is desired, it is better to build two or more separate mills.

It is a good rule in any manufactory to keep on hand the least raw material necessary for regular running, and to sell products about as they are ready for the market. To accumulate raw material is to speculate in it, and to hold the products is equally speculative; and a factory is not necessary if speculation is the object. It is best to accept whatever profit there is in manufacture at current market prices of raw material and products, and when current market prices yield no profit, shut down and wait

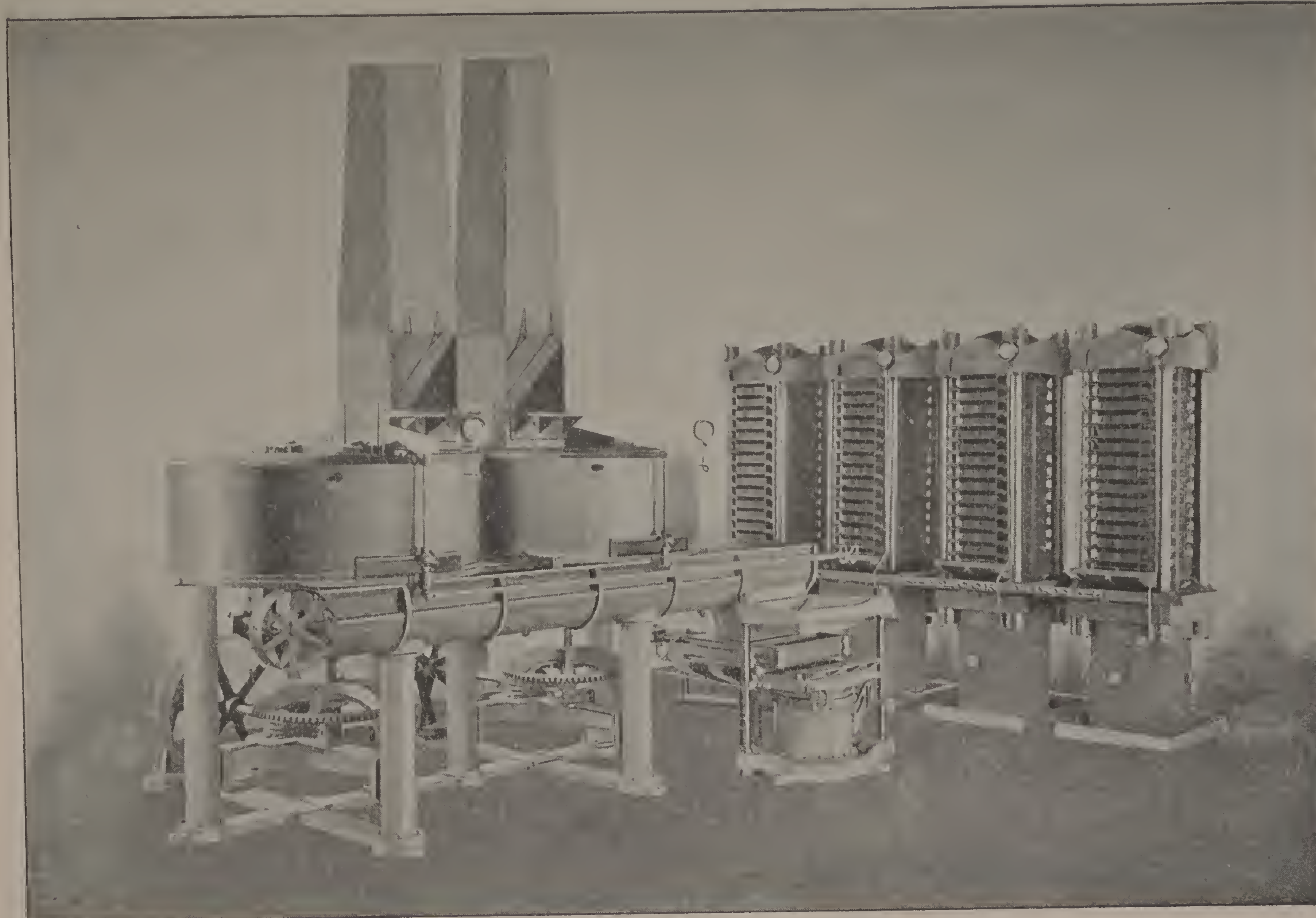

FIG. 7. Heaters, Formers, Presses.

for one or the other of the markets to change. By this plan it is always easy to determine what a factory can afford to pay for raw material.

Whenever a mill is not in condition to operate, by being unfinished or otherwise, it is especially dangerous to accumulate seed. If it seems desirable to purchase them, they should be bought and sold as a mercantile transaction but not held to wait completion of a new mill, or repairs on an old one.

The following table shows complete cost or capital investment necessary for cotton seed oil mills, refineries and cotton ginneries.

TABLE XII. SHOWING COST OF OIL MILL PLANTS.

Capacity for 24 hours, in tons.	Buildings, including Oil Mill, Boiler, Seed and Meal houses.	Land and R. R. Switch and Water Supply.	Press Room Machinery F. O. B. Factory.	All other Machinery in Oil Mill to make crude oil; and plans.	Freight and Erection.	Total Oil Mill, Boilers and Seed and Meal house.	Refinery, including building and all machinery; and plans.	Total Oil Mill and Refinery.	Ginnery, Six Stand Gins, and Cotton Warehouse, and plans.	Total, Oil, Mill, Ginn ry and Refinery.
10 to 15	$ 5,000	$ 1,000	$ 4,500	$ 5,000	$ 2,000	$ 17,500				
20 to 30	10,000	2,000	6,400	8,500	4,500	31,400	$ 11,600	$ 43,000	$ 15,000	$ 58,000
30 to 40	10,000	2,000	8,200	10,000	4,800	35,000	15 000	50,000	15,000	65,000
60 to 80	15,000	2,000	12,500	22,000	8,500	60,000	25,000	85,000	15,000	100,000
100 to 120	22,000	2,500	18,500	34,500	12,500	90,000	35,000	125,000	15,000	140,000

The estimates in table XII. are based on refineries designed to turn out a variety of products, such as summer yellow, butter oil, white oils and miners' oils.

If it is desired to make winter oils also, the cost would be increased about 50 per cent. If only summer yellow oil is to be produced, the cost would be about 50 per cent. less than the table.

The cost of a crude cotton seed oil mill may be said to be about $1,000 per ton (of seed in 24 hours) capacity.

The cost of refinery of about the character contemplated in Table XII. ranges from $300 to $500 per ton capacity of the crude oil mill.

Transportation and Uses of Cotton Oil.

The final test of cotton seed oil is edibility. The highest prices can only be obtained on this basis. When the quality of an oil falls below this, it goes into other uses and brings lower prices. In the early days of the business, this oil was looked upon entirely as an adulterant. It was shipped to Italy and France as an adulterant for olive oil, and was shipped to the lard works or "packing houses" of the United States, as an adulterant for lard. These uses still continue, but are growing into more general favor on the merits of the oil itself. There is still some prejudice against it, and justly so when used as an adulterant. But commerce is becoming accustomed to "compound lard," and "lard compound," and other names suggestive of the mixed character of the product; and the business of making acceptable culinary articles from cotton seed oil has become legitimate and desirable. Some of these compounds contain pure hog lard; while some contain none at all, and are advertised as such. It is estimated that 30 per cent. of the cotton oil produced in the United States is consumed in this manner. Most of the packing houses, where these lard compounds are made, are in the West. This business has recently commenced to grow in the South.

Formerly, owing to lack of skill at the oil mills, the oil was shipped in the crude state, to these distant works,

where it was first refined and then utilized. Latterly, the mills have begun refining the oil before shipping, thus making the additional profit.

Oil is sold nominally by the gallon, but actually by the pound. The commercial gallon of cotton seed oil, crude or refined, weighs $7\frac{1}{2}$ pounds. When oil is sold, the net weight is divided by $7\frac{1}{2}$ in order to reduce it to gallons. In practice, this would often leave awkward fractions, so the custom is to multiply the weight by 2, and divide by 15, thus leaving any fraction as 15ths.

Previous to about 1886, the standard package for both crude and refined cotton oil was second-hand kerosene barrels. These were cleaned with hot steam, until they had no odor of kerosene, and were lined with glue to ensure tightness. If the work of cleaning is properly done, this makes an acceptable package. As the business grew, many became careless in cleaning the barrels, and many used varnish barrels and linseed oil barrels. This engendered a prejudice against all second-hand barrels. At the same time, the demand for second-hand kerosene oil barrels became greater than the supply, and within a very short while, it became the standard practice to use new barrels.

The use of tank cars for domestic shipments has been steadily superseding barrels. Most of the packing houses own large numbers of tank cars, which they send out to oil mills for their oil. Most of the large mills also own tank cars, in which they ship their product, and which they often use for purchasing crude oil from small mills, which are not equipped with refineries. Tank cars for cotton oil generally hold 6,000 to 7,000 gallons, or 45,000 to 52,500 pounds. This is the most convenient way to transport oil of all grades. They are also, to some extent, being used for soap stock, or the residues from refining.

Tank cars are provided with coils of pipe on the inside, so arranged that hot steam may be used to thaw out the oil when it is congealed by cold weather. It is important to see that these coils are always in good order, so that no steam may be blown direct into the oil.

Fig. 8. Steam Former.

Oil for export must, of course, be put up in barrels. It is essential that the barrels be first-class, otherwise there will be great loss from leakage under the numerous handlings which they undergo.

A small amount of oil is now being exported in tank steamships, arranged to carry it in bulk, in compartments. These ships ply between Southern ports of America, where there are large storage tanks, and certain ports of Europe, where there are similar facilities.

About 65 per cent. of all the cotton oil produced in the United States is exported. About one-third of this, being the best grades, goes to Holland, for use in making artificial butter, which reaches its perfection in that country. The finest grades of summer yellow oil are known in the trade as "butter oil." Some of the best grades of oil also go to Southern European ports for admixture with olive oil, and also, to some extent, for an edible oil under its own name. South Europeans have always been accustomed to eating olive oil, as other people eat butter, and the poorer classes accept cotton oil as a cheap substitute. Large quantities of inferior grades, being about one-third of all our exports, go to Marseilles and neighboring ports for soap making.

Inferior oils are frequently bleached by sulphuric acid at the refineries into "white oil," and used as an illuminant, in place of lard oil. The principal use of this oil is for admixture with petroleums of high flashing point, to be burned in miners' lamps. This grade of white cotton oil is generally known as "miners' oil." It should not be confused with prime white oil, which is bleached from first quality summer yellow, by the use of fullers earth, and which is used in compound lard.

There are many minor uses for cotton oil, among which may be mentioned the packing of sardines and similar fish. It has been frequently tried as an adulterant for linseed oil, or as a substitute for it, in painting. The difficulty has always been, that in its natural state, cotton oil will not dry out and leave the paint hard. Numerous

processes have been exploited for making it into a drying oil; but none have so far been a commercial success. It has often been tried as a lubricant, but its gummy nature prevents any success in this field, except for the most ordinary purposes. Several processes have been tried for removing the gum or resin. There have been some laboratory experiments, which seem to indicate that a useful gum may be extracted and used as a substitute for rubber, while leaving the oil in a condition to use as a lubricant, but as yet, these processes have not been commercially successful.

Transportation and Uses of Cotton Seed Meal.

When the oil has been extracted by hydraulic presses, there remains the cake. Formerly, when the presses were differently constructed and the processes were somewhat different, this cake was softer than it is at the present time. It was largely exported as cake, and sold for cattle food. It was broken into pieces and fed, in connection with other material. In some cases it was ground fine, after being exported, and fed in this condition. It has been found that the finely ground meal mixes more readily, and is more digestible than cake, and so the practice of feeding cake has been nearly abandoned. The Germans were the first to realize the value of fine grinding. From the beginning of the business, very small quantities of cake, and large quantities of meal were exported to Germany, while England and other countries preferred cake. In some cases this preference for cake was caused by the fear of adulteration in meal.

Cake was formerly packed into coarse second-hand gunny sacks and driven in with a mallet, in order to make a firm package. These packages varied in weight, but generally weighed about 200 pounds.

Meal for export is ground very fine, and bolted clean. It is generally put up in 100 pound sacks, as one-twentieth of a "short ton" of 2,000 pounds; but for special orders it is sometimes put up in 112 pound sacks, as one-twentieth of the "long ton," of 2,240 pounds, and sometimes in

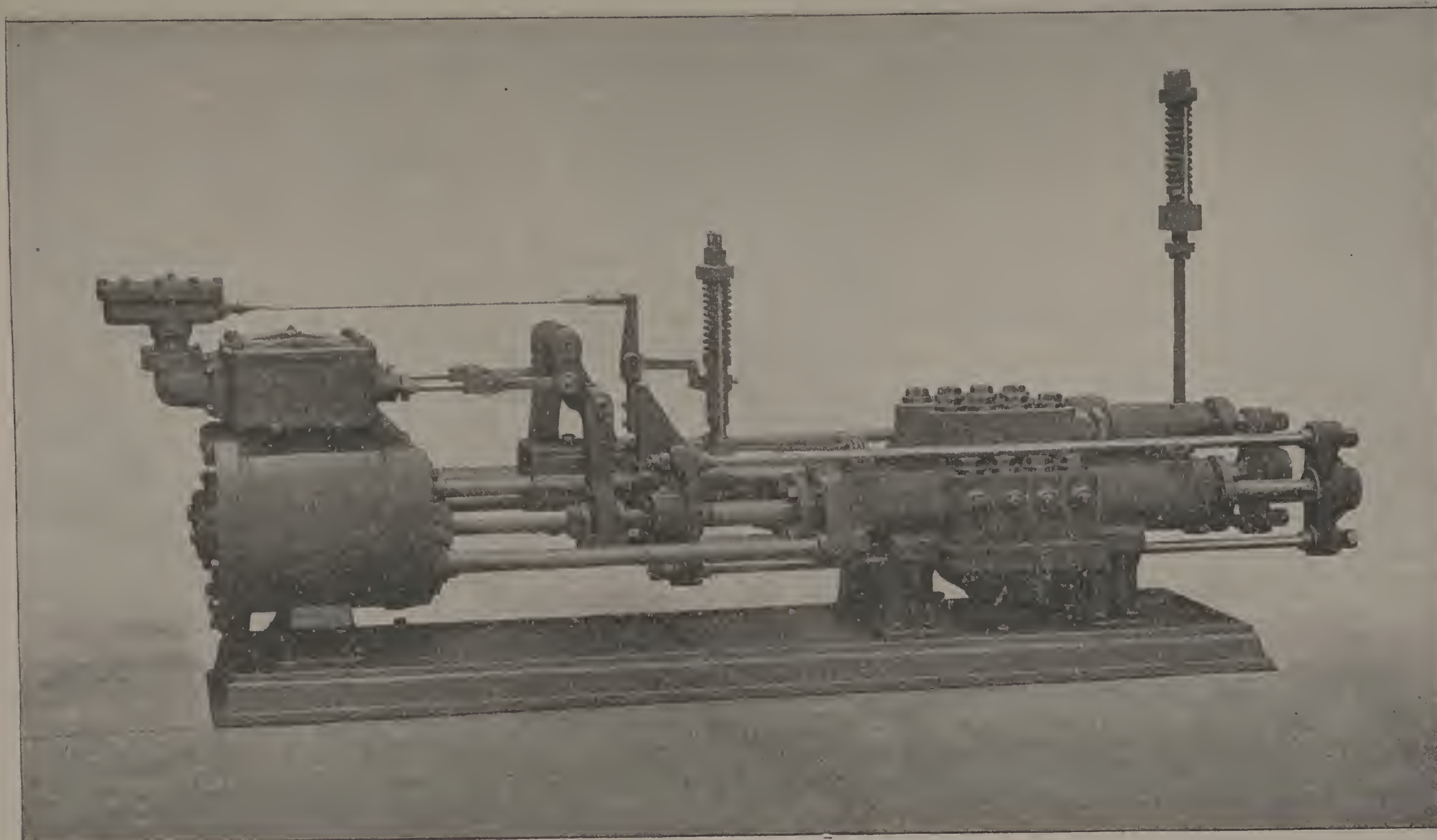

FIG. 9. Hydraulic Steam Pump.

110 pounds sacks, as 50 kilograms. All meal for domestic trade is put up in 100 pound sacks.

The domestic demand was at first entirely as a fertilizer, both for use direct on the soil, and for mixing with other ingredients to make a commercial fertilizer. This demand grew to immense proportions in the Southeastern States, where fertilizers were universally used. From 1880 to 1890, about 90 per cent. of the meal made in that section was used for fertilizer, about 5 per cent. was exported, and the remainder was fed to cattle.

In the Southwest, where but little fertilizer was required, about 75 per cent. of the meal and cake was exported to Europe for cattle feeding, while the remainder was fed to cattle, at home.

At the present time, cattle feeding has become such an extensive business, both in the Southeast and Southwest, that of the whole amount of meal produced in both sections, about 35 per cent is fed to cattle, about 35 per cent. is used for fertilizers, and the remainder is exported for feed.

It has been so clearly demonstrated by experiment stations, and by other practical tests, that the principal value of cotton seed meal lies in its feeding, rather than its fertilizing qualities, that it is only a matter of time when practically all of the meal will be fed. The fertilizer works are already accommodating themselves to this condition, and are partly substituting other sources of nitrogen for the cotton seed meal.

The sacks, in which meal is shipped, consist largely of second hand wheat sacks, made originally to hold 100 pounds of wheat for export from California to the Orient. These sacks are often re-shipped with linseed to Eastern ports of the United States. When the linseed is used, the sacks are cleaned and put up in bales of 1,000, and sold to cotton oil mills. Fertilizer factories and cattle feeders frequently return sacks to the oil mills, to be used again and again. Meal is sold by gross weight, that is, no deduction is made for the weight of the sacks.

It is very difficult to empty absolutely all the meal from

the sacks, and hence the returned sacks are somewhat heavier than they were at first, so that notwithstanding their damaged condition, necessitating repairs, the oil mills are always willing to allow consumers the full price of new sacks for all those returned.

Transportation and Uses of Cotton Seed Hulls.

The first use of cotton seed hulls was for fuel to run the oil mills. Mills of forty tons (seed) capacity, and upward, always made enough hulls for a full supply of fuel, even with very ordinary steam plants; with good, economical engines, there was considerable surplus; the larger the mill, the greater the surplus. It soon became a problem to dispose of this large amount of useless product. It was difficult to even give it away. The bulky and light nature of the material, made it difficult of transportation, and so it was not of much fuel value to other plants located at a distance from the oil mill. A ton, in its loose state, occupies about 300 cubic feet, and is equal in fuel value to one-quarter ton of coal, which occupies about ten cubic feet.

The use of cotton seed hulls as a cattle food was tried experimentally in the early days of the oil mill, but its true value, in comparison with other food stuffs was not realized until 1885 to 1890. About this time, systematic cattle feeding commenced, as an adjunct to oil milling in the Southwest. Large herds of Texas cattle were bought at low rates, and fed in pens near the mills, and when fat, shipped to the packing houses. The value of hulls as a cattle food was thus practically demonstrated on a large scale, so that there arose a steady demand for hulls from many sources, all over the cotton growing States. The problem of transportation then began to receive attention. Hulls were at first shipped in bulk in box cars. By careful tramping, about twelve tons may be loaded into a car. Many hulls are still shipped in this way, some are put up by machinery into sacks; but the most general method is to pack them into bales about two feet square, weighing about 100 pounds. In this shape, 15 tons may be easily and quickly loaded into a box car.

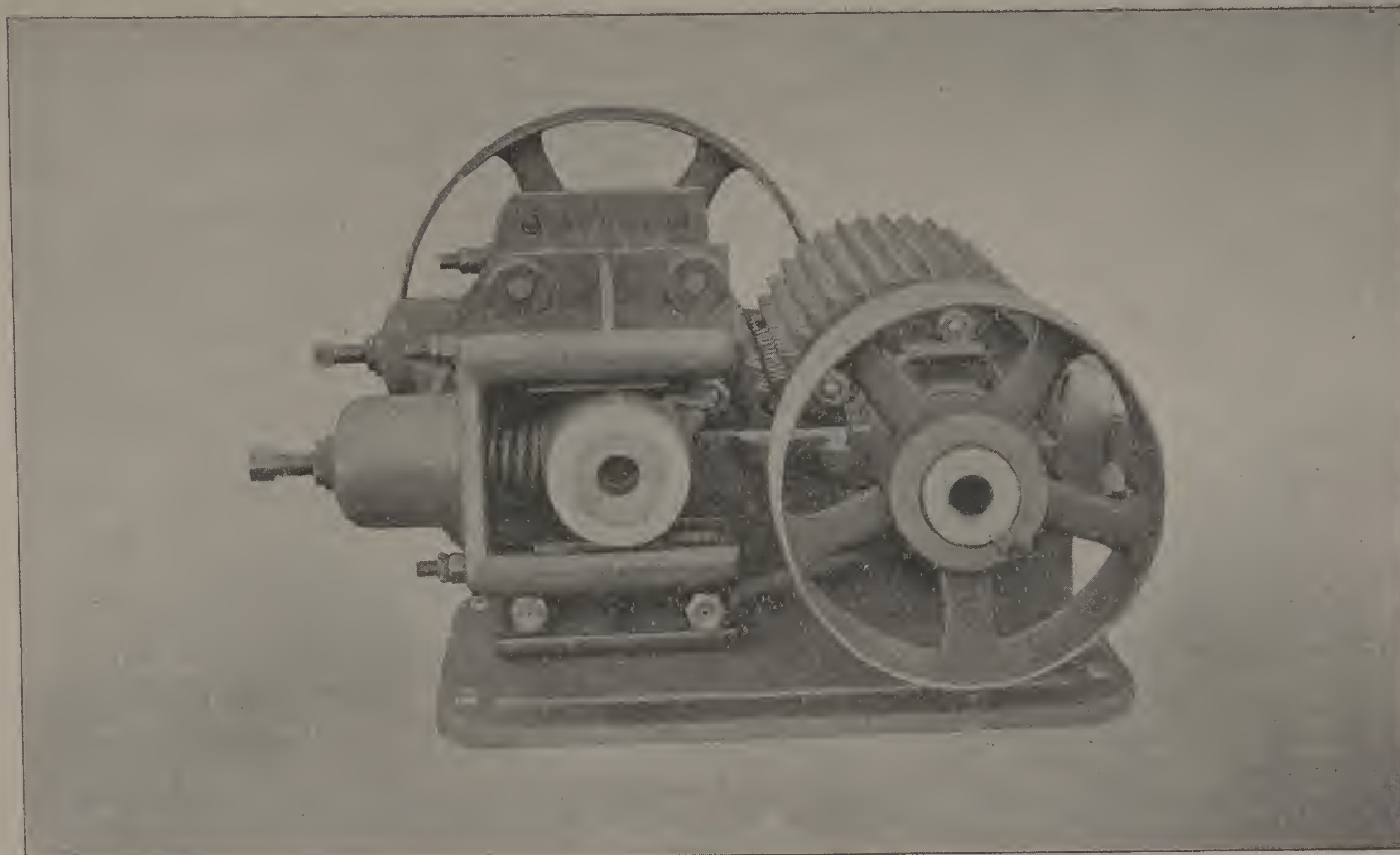

Fig. 10. Cake Cracker.

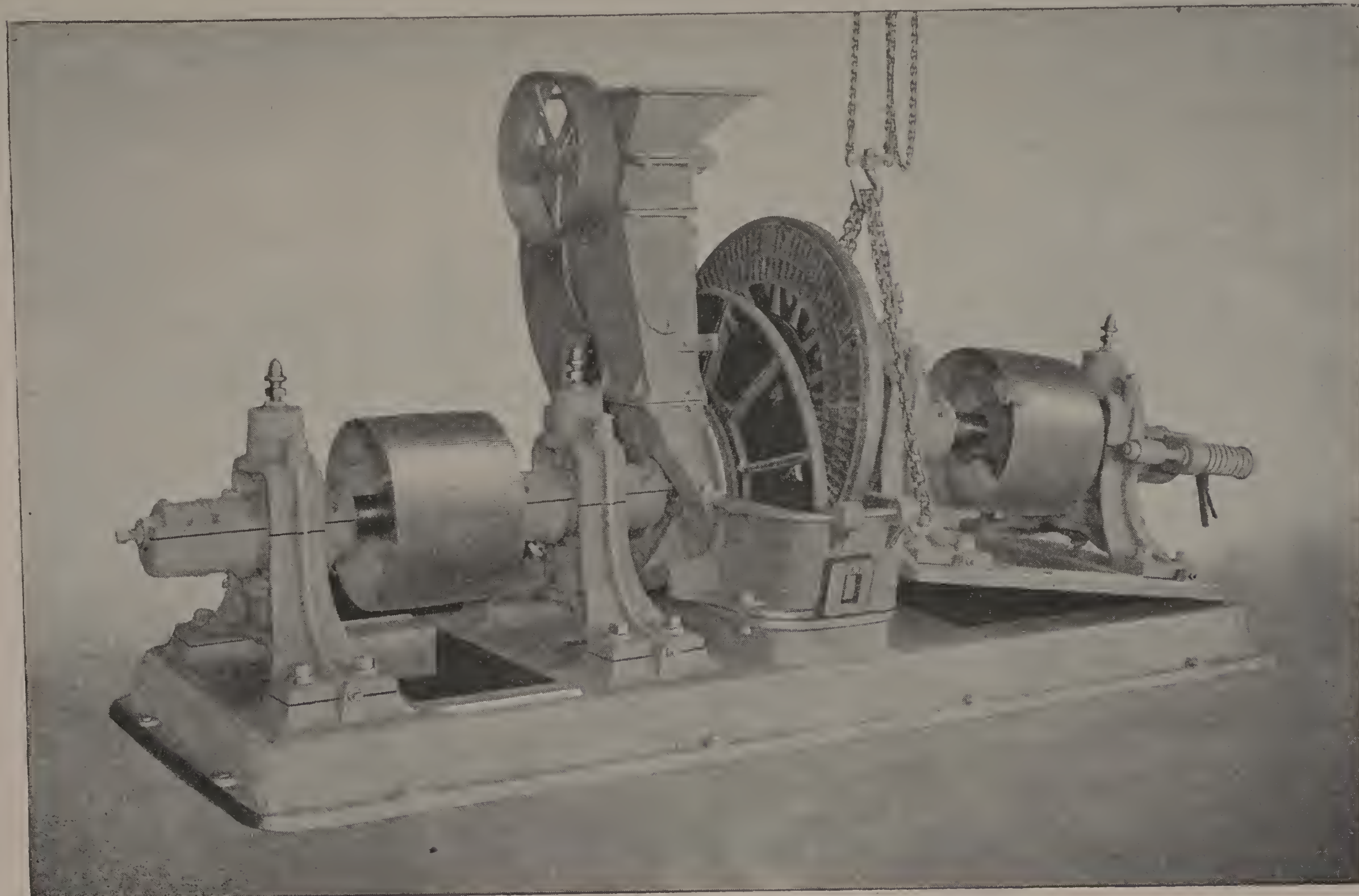

FIG 11. Cake Mill.

The style of bale now in use is not entirely satisfactory, for the reason that it is only partially covered, and there is great waste in handling. There is a demand for some better method of packing cotton seed hulls for shipment.

TABLE XIII.

SHOWING VALUE AND AMOUNT OF SEED, CRUSHED, AND VALUE OF CRUDE MILL PRODUCTS, 1870 TO 1900.

Year.	No. of Mills.	Tons of Seed.	Value of Seed.	Value of Products.
1870	26	80,000	$ 640,000	$ 1,500,000
1875	35	150,000	1,500,000	2,900,000
1880	45	280,000	2,800,000	5,100,000
1885	80	550,000	5,500,000	9,600,000
1890	119	1,000,000	12,000,000	23.800,000
1895	250	1,800,000	21,600,000	33,000,000
1900	400	1,900,000	23,800,000	35,000,000

High Efficiency of Presses.

To get best work out of presses, the slack should be taken up quickly when the press is filled.

Saving Press Cloth.

To save press cloth, the pressure above 500 pounds should go on very slowly. By this method, there is also less meal squeezed out with the oil.

How to Accomplish the Above.

We have designed a simple and effective method for taking up the slack of the presses very quickly, and putting on the high pressure very gradually.

The only machinery necessary is a high and a low pressure pump and an automatic valve.

A mill having a high pressure pump would only have to get a low pressure pump and the valve.
have to get the valve.

A mill having a high and a low pressure pump would only
pler automatic valve in place of one or both accumulators,
ple automatic valve in place of one or both accumulators.

The following is a description of our automatic valve (patent applied for), and its connections with the pumps and presses. The description and engravings are taken from the book "Cotton and Cotton Oil," by D. A. Tompkns (copyrighted and used here by permission):

Improved Automatic Change Valve, Fig. 107-Lettering

Fig. 107 shows a cross section of an improved change valve, having fewer parts than any of the old forms. Both high and low pressure pumps are connected to this valve.

A.—Pipe from low pressure pump.
B.—Check over same.
C.—Port to press pipe.
D.—Pipe to press.
E.—Pipe from high pressure pump.
F.—Choke valve.
G.—Stop valve. high pressure.
H.—Stop valve, low pressure.
J.—Crimp packing.
K.—Leather gasket.

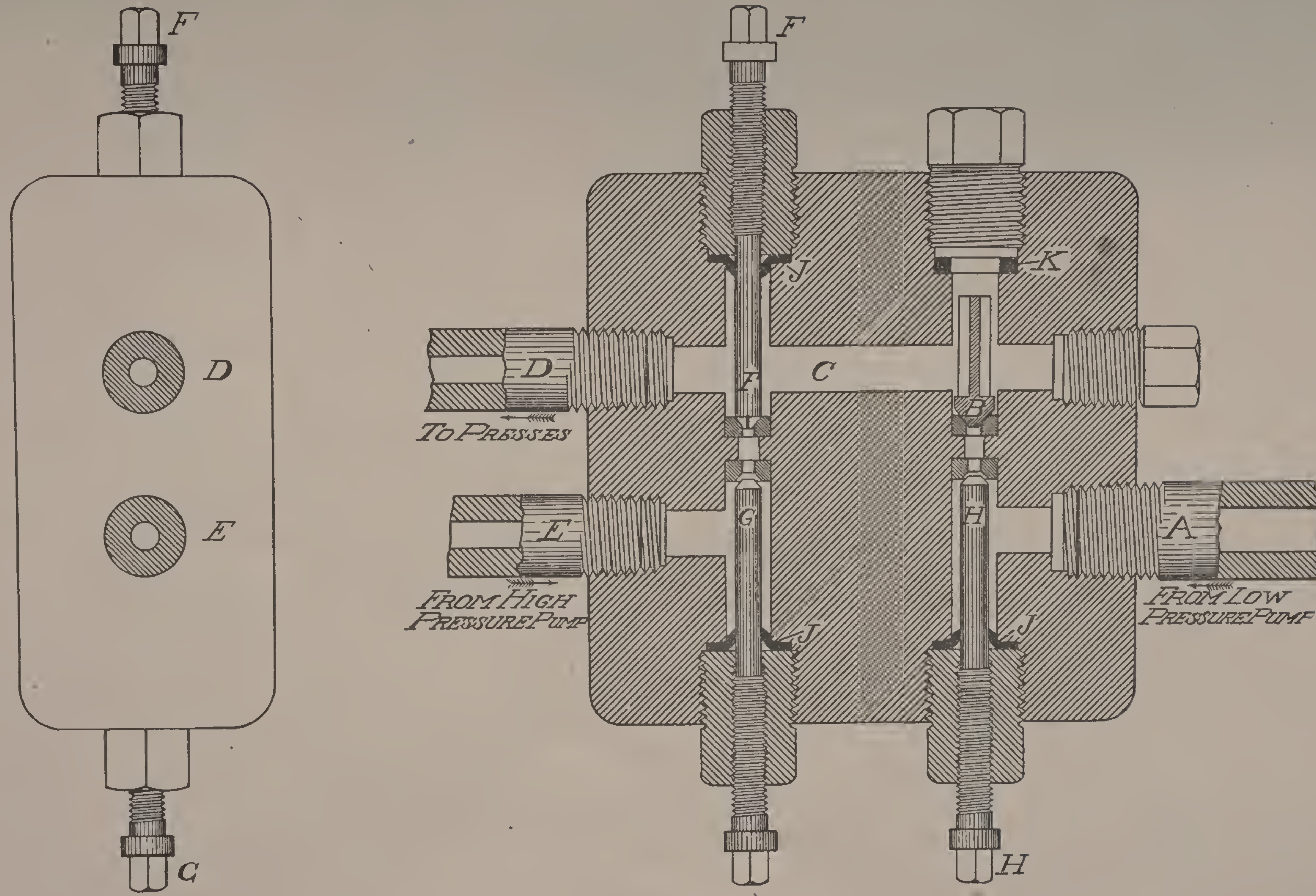

FIG. 107. New Style Automatic Change Valve.

When valve at press is first opened, low pressure flows through pipe A and check B, to press.

At the same time the high pressure pump forces oil through the slot in choke valve F. (This slot is a mere notch filed across face of valve.)

As oil passes through this choke valve its pressure becomes as low as the pressure from the low pressure pump. Thus both pumps contributes to hasten the ram, and when comes as low as the pressure from low pressure pump. continuing to put oil through the choke valve F, gradually raises the pressure to above that of the low pressure pump. Then the check B closes, and the pressure continues to rise by the action of the high pressure pump alone. The choke valve makes this rise of pressure very gradual, and it is this regulation of the rise which saves the press cloth and makes a greater yield of oil from the presses.

Fig. 108 shows a high and low pressure pump, piped up to three presses. More presses could be added if desired.

A.—Low pressure pump.
B.—High pressure pump.
C.—Automatic change valve.
D.—Side view of automatic change valve.
E. H.—Press change valves.
F.—Pipe to press.
G.—Presses.
K.—Discharge pipe to tank.

The automatic change valve C (see Fig. 107), is put near pumps. By this plan only one line of the pipes is required, to go from the automatic change valve to as many presses as one set of pumps will supply.

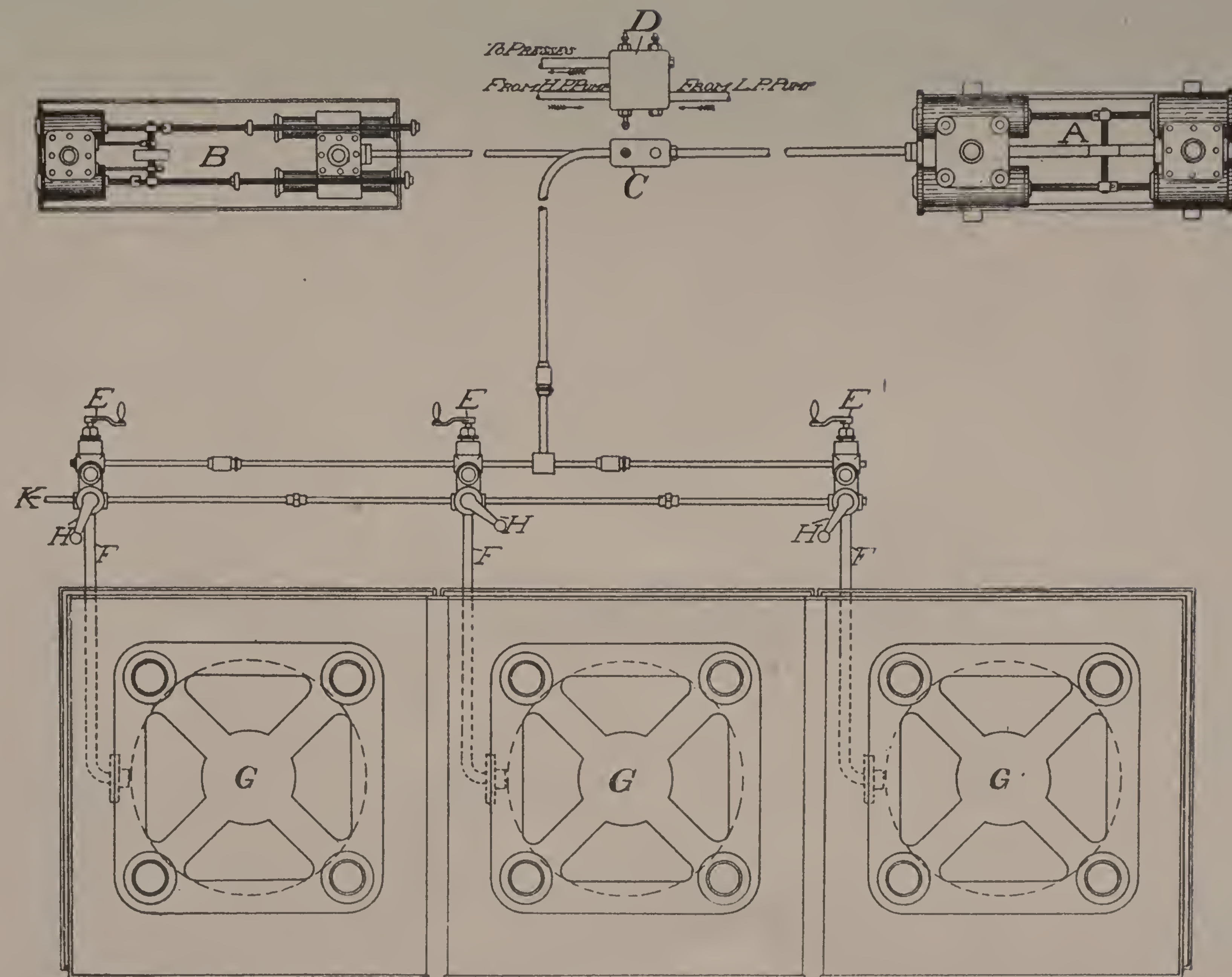

FIG. 108. Pump and Press Connections.

Oil Mill Machinery.

(SEE ILLUSTRATIONS.)

Sand and Boll Screen

Is made to clean the seed. It takes out everything larger than a seed and also everything smaller than a seed. For mills of 40 tons capacity and under, we build the combination screen shown; for larger mills, we build two separate machines, one for sand and one for bolls. All of these machines are built complete in our shop, and shipped knocked down; but the parts are so carefully marked that there is no trouble in setting them up in the mill. Each machine is self contained, and complete within itself. One belt drives all the parts, including elevators and conveyors.

Linter.

This machine has 106 saws. The cylinder is made with iron or wood space blocks as desired. It has a capacity of 5 to 10 tons of seed per day of 24 hours. The less seed passed through one linter, the more lint is made per ton of seed.

Huller.

This is built in two sizes, No. 1 and No. 2. The capacities are 30 and 80 tons of seed per day respectively.

Huller Feeder.

This machine is designed to accomplish two results, (1) to regularly feed the seed, (2) to prevent foreign matter larger than a seed from going through to the huller. It is adjustable to any desired amount of feed.

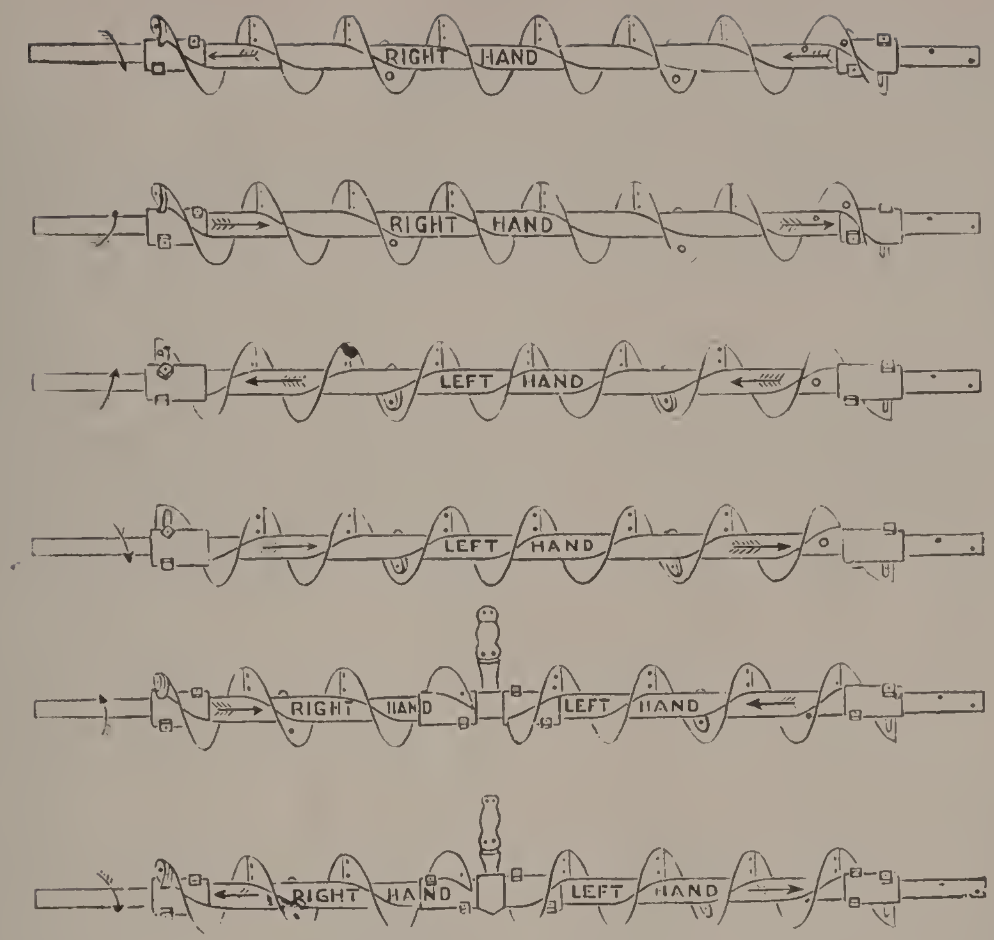

FIG. 14. Conveyors.

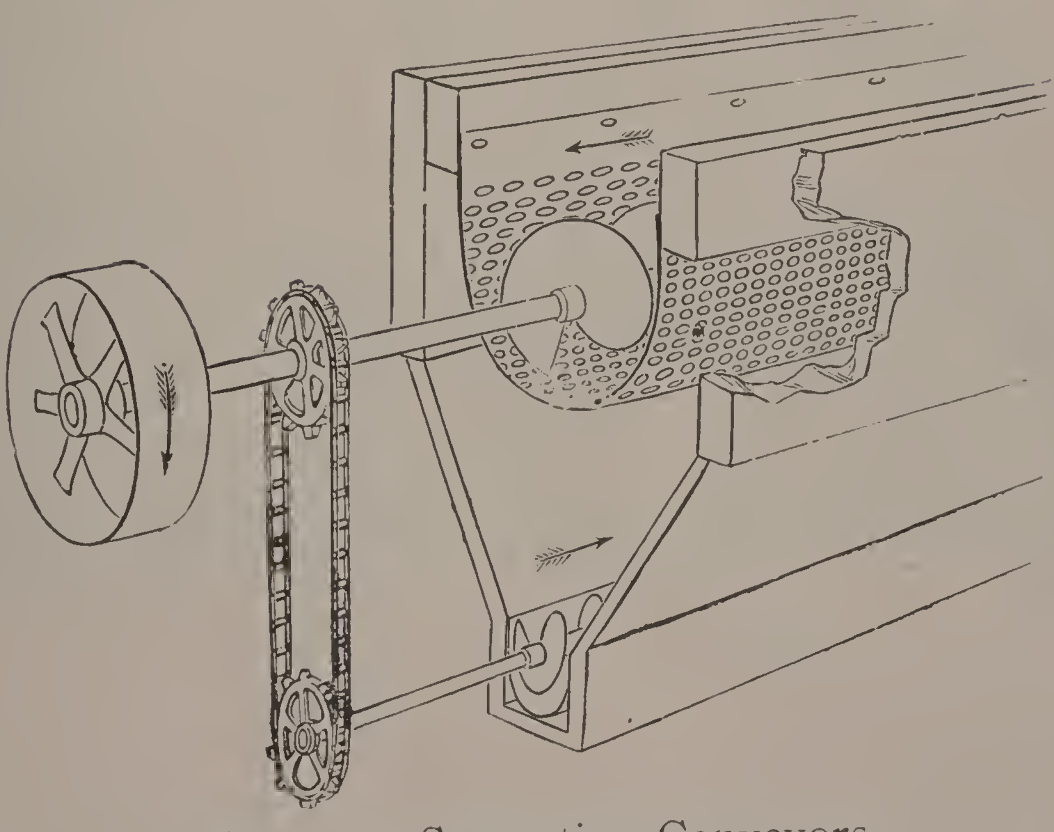

FIG. 15. Separating Conveyors.

Separating Screen.

This is similar in construction and appearance to the sand and boll screen. It is provided with a shaker underneath, to make the separation more perfect. It is self-contained, and is driven in the same manner as the sand and boll screen.

Rolls.

The illustration shows a set of rolls suitable for a 100-ton mill. We furnish all sizes. The illustration shows the upper rolls driven by gear. We also furnish them driven by belts.

Heaters, Former, Presses.

The illustration shows two 72-inch heaters, one former and two presses. These heaters are driven from a shaft underneath. We also furnish them driven from overhead if desired. We have two sizes: 52-inch and 72-inch. We arrange them as shown, or in "triple style," as required. Our heaters are of solid cast iron, without seams. The steam jacket is cast with the heater body. The entire outside is jacketed with felt and finished up with Russia iron covering. They are provided with charging hoppers and easy working charging gates.

Former.

The illustration shows the self-acting steam carriage style. This has a separate direct acting steam cylinder to operate the carriage which distributes the meats in the former bed. We also furnish formers with hand carriage when desired.

Presses.

These have steel plates with extra strong side walls, and with ample drainage capacity. We furnish brass plates on special orders. We furnish presses with 12 plates, or with 15 plates as desired.

Hydraulic Pump.

We furnish all sizes and styles of hydraulic pumps, both belt driven and independent steam driven, such as shown

Fig. 16. Lint Baling Press.

in the illustrations. They are made for low pressure or for high pressure as desired. They all have automatic and positive pressure regulators.

Cake Cracker.

This is to crack the cake preparatory to grinding. It is extra strong and does its work perfectly.

Cake Mill.

The illustration shows a style of mill which we have used with the best success for the past five years. It will grind meal to any desired degree of fineness. If properly used it grinds meal ready for export without bolting. If it is desired to bolt it, we also furnish machinery for this purpose. We have several different sizes.

Linter Press.

This may be made to pack up or down. One press will pack all the lint made in a hundred-ton mill.

Hull Baling Press.

We furnish the strongest press made for this purpose. It turns out perfect bales, and is easily operated.

Saw Sharpener.

Linter saws should be sharpened frequently. The illustration shows a perfect machine for the purpose. We have them with single heads and with double heads. When desired, we furnish a gummer attachment, to keep the teeth in good shape, and keep them from from wearing too short.

Filter Press.

We build filter presses for refineries. They have 18 plates or 24 plates. The large one is suitable for a refinery with a 150-ton mill. Many crude oil mills now use filters for their crude oil.

Conveyors.

We furnish only the best steel flight conveyors. They are right or left hand, as shown in the illustration.

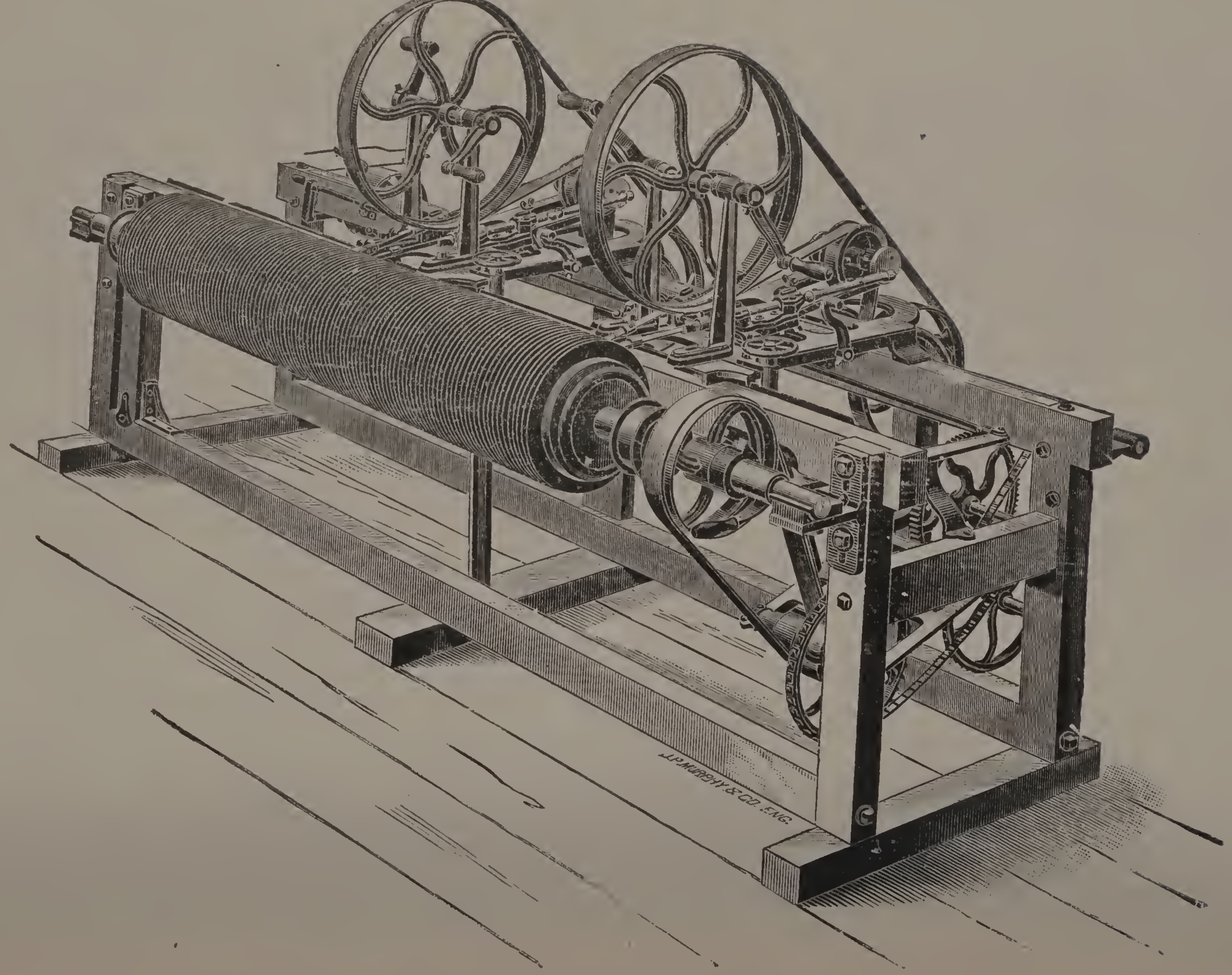

FIG. 17. Linter Saw Filer.

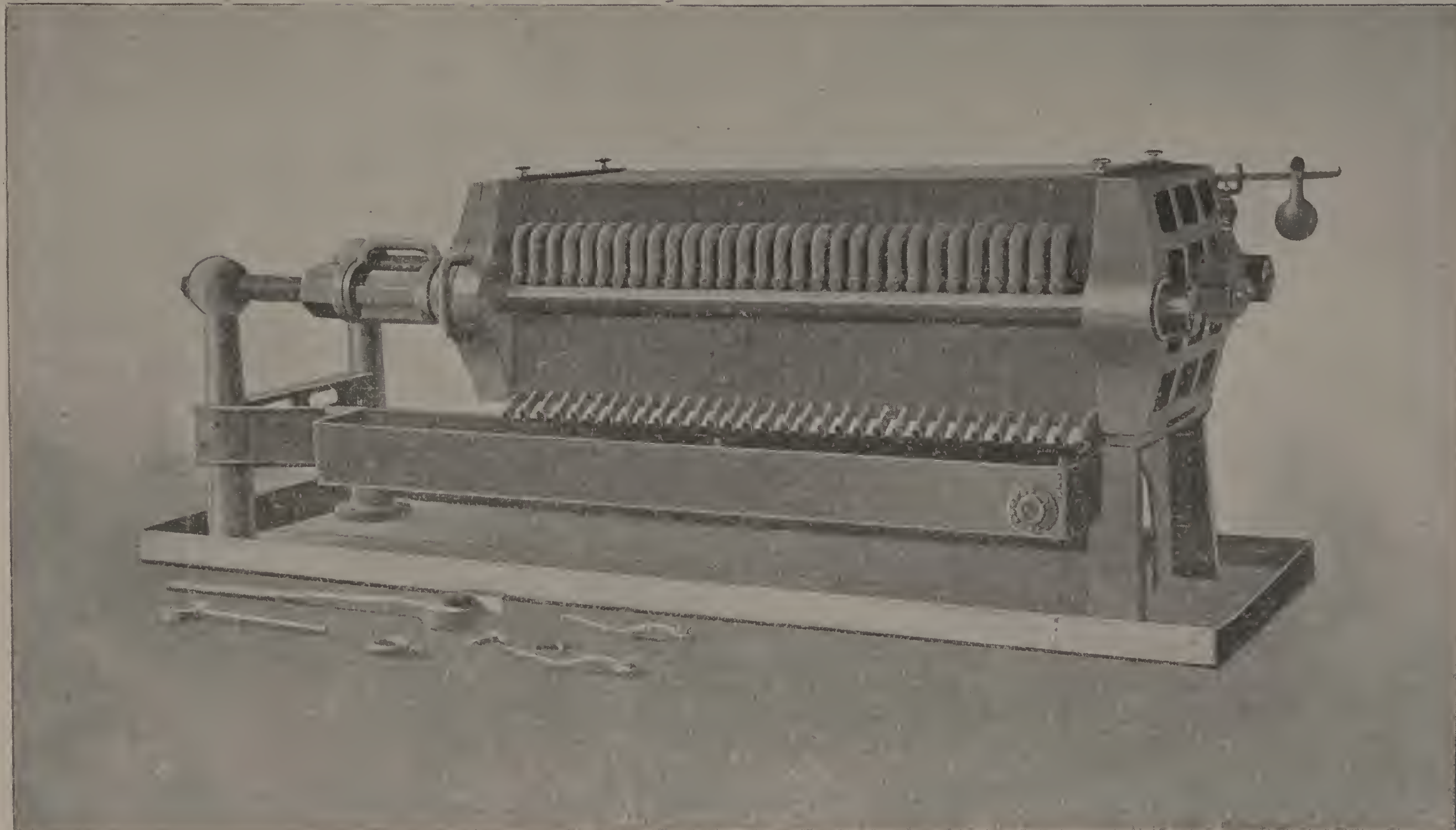

Fig. 18. Filter Press.

Separating Conveyor.

The illustration shows a form of separator made of conveyors. This is a convenient arrangement for getting the last remaining meats out of the hulls, as they are carried from the mill to the hull house.

Elevators.

We furnish elevator cups, bolts, belts, and all necessary fixtures.

Steam Pressure Reducing Valve.

These valves may be used for two different purposes: (1) to put in the steam pipe leading to the hydraulic pump, and reduce the steam pressure. This in turn limits the hydraulic pressure made by the pump to any desired extent, regardless of the boiler pressure.

(2) To put in the steam pipe leading to the steam jacket of the cooking heaters.

If the boiler pressure is 100 pounds per square inch, and ouly 50 pounds is desired on the heater, this reducing valve will maintain the pressure constantly at the point desired. Many kinds of reducing valves give trouble, ours do not.

In ordering valves, state what service they are expected to perform.

Hydraulic Pressure Regulators.

These regulators are operated by hydraulic pressure, so that when the pressure reaches any desired point the pump stops.

The regulator accomplishes in a different way the same results as the pressure-reducing valve.

Either machine will give the desired result.

Hydraulic Safety Valve.

No matter what regulator is used on a hydraulic pump, a safety valve is necessary. We furnish them, set for any desired pressure.

FIG. 19. Steam Trap.

Steam Traps.

Every heater in a cotton seed oil mill ought to have a trap on it, to drain out the condensed water. If condensed water remains in a heater, it will get cold and will not cook properly. Many kinds of traps will not work. Ours is simple, and when once adjusted cannot fail to work. It has no float or other movable part. We furnish several different sizes.

Fire Protection.

We build towers and tanks of all kinds for fire protection. These may be either iron or steel.

Oil Tanks.

We build steel tanks, with or without covers, for storage of cotton seed oil.

Improvements.

All the illustrations shown are from machines built for actual service. We are constantly improving our machinery. These improvements necessitate changes of design and of arrangement. We therefore reserve the right to make such changes as in our judgment may seem to be of advantage to our customers and ourselves.

The purpose of this note is that no fault will be found if machines built after this pamphlet is issued should not be as shown in these illustrations.

Repairs.

We are prepared to make in our machine shop, and furnish any repairs for oil mills or cotton mills. We make patterns when necessary. We send out experts to examine into the operation of a mill and report on economies. We make a special valve to save press cloth.

We make a hydraulic change valve for use with high and low pressure pumps.

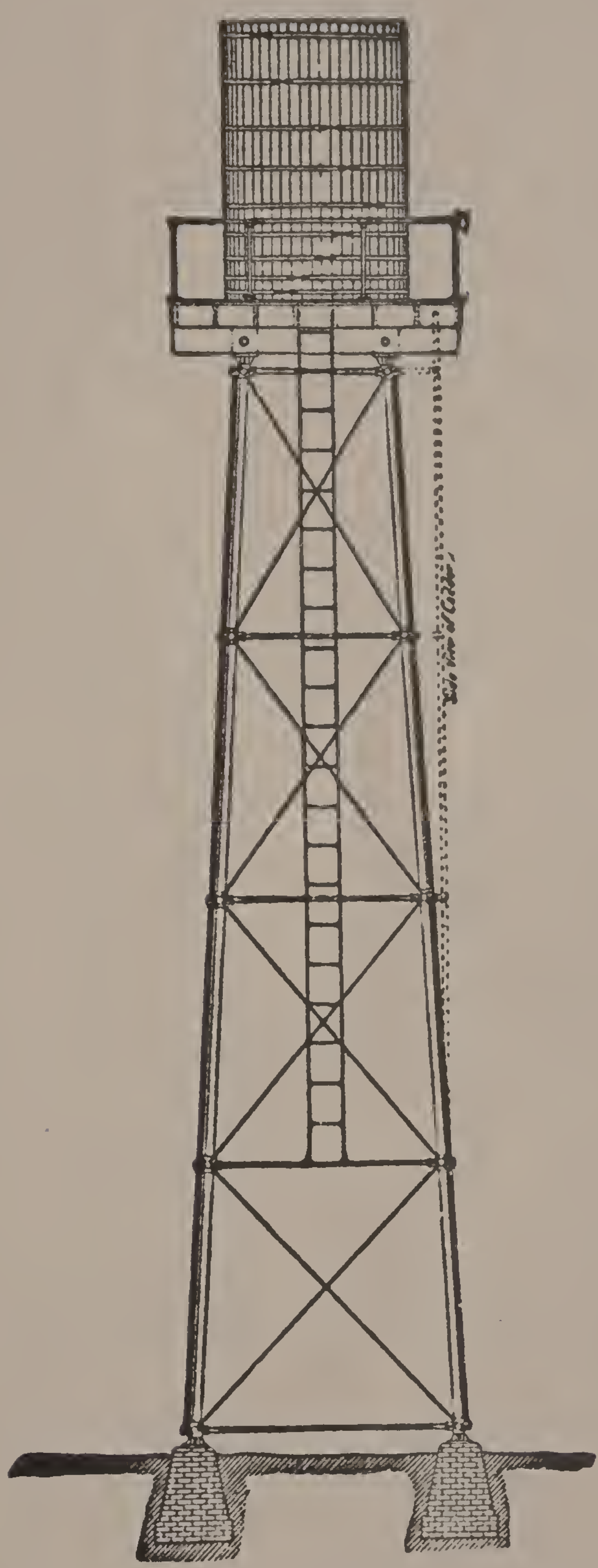

FIG. 20. Tower and Tank.

In our machine shop we make and cut gears of all kinds. Besides ordinary gear-cutting machines we have one of the largest and most improved gear-cutters in the South.

We have the largest pipe-cutting machine in this section, and are prepared to cut and fit pipe of all sizes.

We have boring bars and all appliances to refit Corliss engines, rebore the cylinders, rebore the valves, and make new valves when necessary, and are prepared to put in new crank pins. In short, we do any repairs or overhauling on Corliss engines, and have competent men to send out with indicators to test and examine Corliss engines and report the condition.

Designers and Builders.

We make complete plans and specifications, and build cotton mills and cotton seed oil mills from ground to finish, and install with the best machinery made.

Fertilizers.

Fig. 19 shows the outside appearance of a fertilizer mixer we build in our shops. We have put out a number of these mixers and they have worked with entire satisfaction.

For full discussion of the subject of manufacture and mixing of fertilizers of all kinds, see the book "Cotton and Cotton Oil," by D. A. Tompkins, Chapter XV. In this is given full list of material commonly used, and formula for mixing.

THE D. A. TOMPKINS CO., Charlotte, N. C.,
Engineers, Machinists and Contractors.

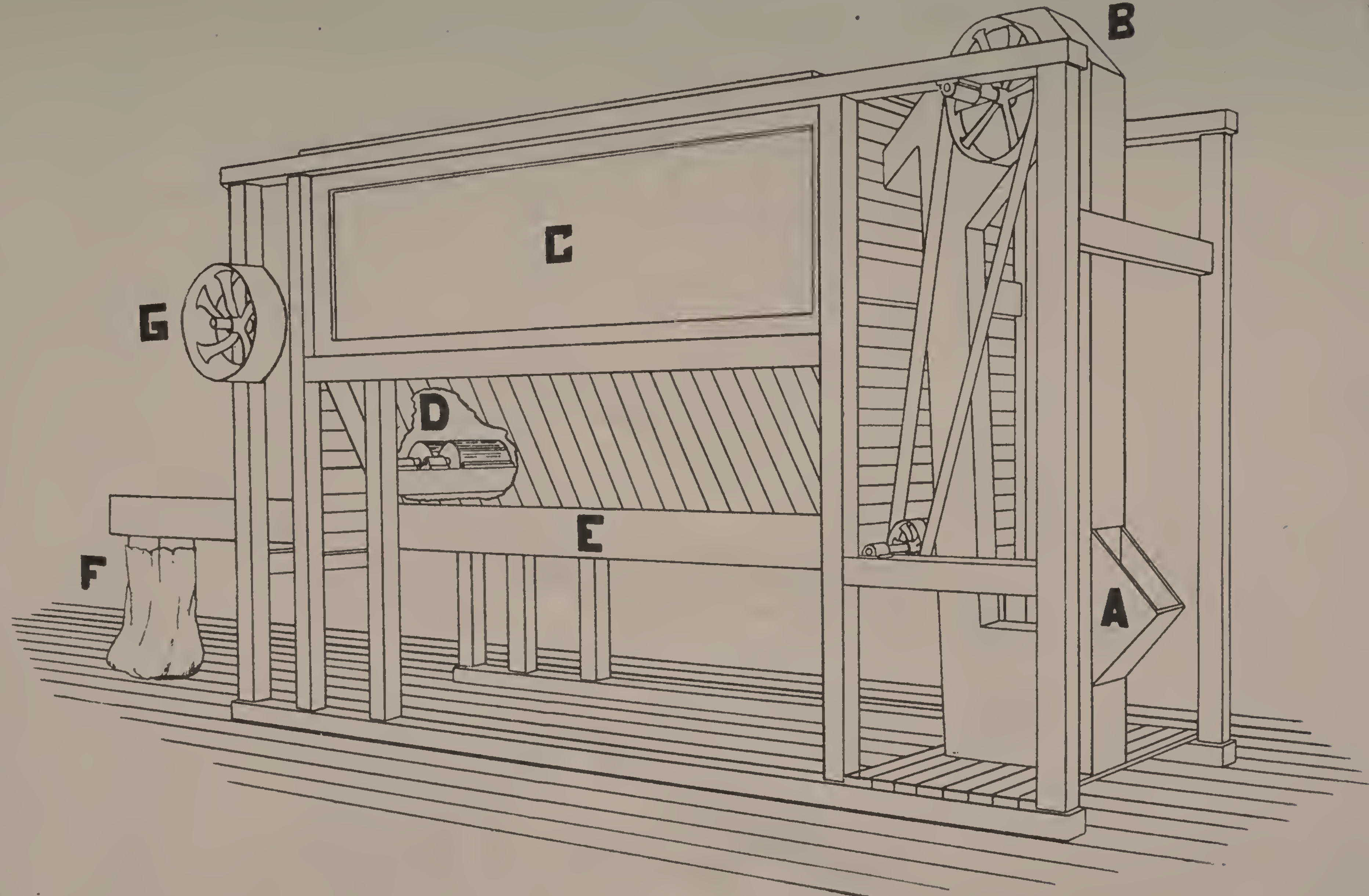

FIG. 21. Tompkins Fertilizer Mixer.

NEW BOOKS

By D. A. TOMPKINS.

Cotton and Cotton Oil, 1 Vol. complete......	$7.50
Or in two volumes, as follows:	
Vol. I., Cotton........	5 00
Vol. II., Cotton Oil	5.00
Cotton Mill, Commercial Features	5.00
Cotton Mill, Processes and Calculations...	5.00
Cotton Values in Textile Fabrics	2.50
American Commerce, Its Expansion	1.00
Working People, Their Savings and Their Homes	1.00

COTTON AND COTTON OIL.

By D. A. TOMPKINS, Charlotte, N. C.

Contents.

CHAPTER IV.

THE PLANTATION BEFORE THE CIVIL WAR.—

General organization of plantation. Home products and economy. Amusements on the plantation. Combination of work and play. The master. The overseer. The slave. Plantation during the war. Loyalty of the slave to the master and master to slave.

CHAPTER V.

PREPARATION OF COTTON FOR THE MARKET AS MODIFIED BY THE ABOLITION OF SLAVERY.—

White man meets new conditions and adapts himself. Improved machinery. Labor saving inventions. Increased production.

CHAPTER VI.

MODERN COTTON GIN, PRESS AND GINNERY.—

History of improvements on gin. Evolution of the gin house. Intermediate stages. Present types. Round bale. Compresses.

CHAPTER VII.

PLANTING, CULTIVATION AND HARVESTING COTTON.—

Preparation of ground Time to plant. Chopping out. Plowing. Fertilizing. Implements of culture. Insect enemies. Picking and harvesting.

CHAPTER VIII.

MARKETING COTTON.—

Ante-bellum factor methods. Post-bellum methods. Middle men. Exporting.

CHAPTER IX.

THE PLANTATION, DURING AND AFTER THE CIVIL WAR.—

With slave labor. With emancipated negro labor. Methods of paying laborers. Renters, tenants, croppers, day wages. Influence of cotton factories. Influence of cotton oil mills. Neighboring manufacturing enterprises make farming more attractive. Farm lands increasing in value.

PART II. COTTON OIL.

CHAPTER X.

COTTON SEED.—

Constituent elements, oil, meal, lint, hulls. Microscopic study of seed. Varieties and their relative values to oil mills.

CHAPTER XI.

COTTON SEED OIL, COMMERCIAL FEATURES.—

History of oil milling. Purchasing seed. Uses made of various products. Value of products. Markets for products. Packages for products. Table showing quantities and values of products for 30 years.

CHAPTER XII.

COTTON SEED OIL, MECHANICAL FEATURES AND PROCESSES.—

Detailed description of each machine and its operations. Table showing speed and power for each machine. Quality of raw material and its relation to finished products. Mill buildings. How to reduce fire risks by proper construction.

CHAPTER XIII.

COTTON SEED OIL REFINING.—

Chemical considerations. Mechanical considerations. Old methods. Present practice. Variety of finished products. By products. Suitable buildings. Storage tanks.

CHAPTER XIV.

CATTLE FEEDING.—

Early experiments. Government investigations. Growth in the Southwest. Introduction into the Southeast. Varieties of cattle for feeding. Markets for fatted cattle. Transportation of cattle. By products.

PART III. CORRELATED INDUSTRIES.

CHAPTER XV.

FERTILIZERS.—

Composition and uses. Manipulating and mixing on the farm. Raw materials. Manipulating and mixing at small oil mills. Cotton seed meal as a raw material. Experiment station work.

CHAPTER XVI.

FERTILIZER MANUFACTURE.—

Chemical considerations. Mechanical considerations. Machinery. Raw materials. Phosphate rock. Pebble phosphate. Sulphuric acid in its relation to fertilizers. Manufacture of sulphuric acid.

APPENDIX.

DOCUMENTS RELATING TO INVENTION OF COTTON GIN. TABLES AND MISCELLANY.—

Verbatim court records in cotton gin cases. Theory of cattle feeding. Sundry notes on cattle feeding.

This book will contain over 500 pages and over 100 original engravings. Price, complete in one volume, $7.50; or in two volumes, price $5.00 each.

ORDER FROM D. A TOMPKINS, CHARLOTTE, N. C.

Other Books by D. A. Tompkins.

Cotton Mill, Commercial Features.

This is a book for the intending investor in cotton mill properties, and for the use of those who are now operating them. It contains tables, showing costs of different kinds of mills, and costs of operating on different classes of products. 240 pages, 70 full page engravings. Bound in cloth. [PRICE $5.00.]

Cotton Mill, Processes and Calculations.

This is a text book for the use of textile schools and for mill superintendents, overseers and ambitious operatives. It discusses in minute detail every machine and process and calculations, needed in the cotton mill. 312 pages. 52 full page engravings. Bound in cloth. [PRICE $5.00.]

American Commerce, Its Expansion.

A collection of essays and addresses relating to the extension of foreign markets for American manufacturers. 154 pages. Bound in cloth. [PRICE $1.00.]

Cotton Values in Textile Fabrics.

A collection of cloth samples, bound in book form and arranged, to show the value of cotton when converted into different kinds of cloth. Tables showing the value of a crop of 500,000 bales when manufactured. 18 samples. Bound in cloth. [PRICE $2.50.]

Working People, Their Savings and Their Homes.

[PRICE $1.00.]

FROM D. A TOMPKINS, CHARLOTTE, N. C.